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Operation, Maintenance and Service Manual
Complete with Illustrated Parts Catalog

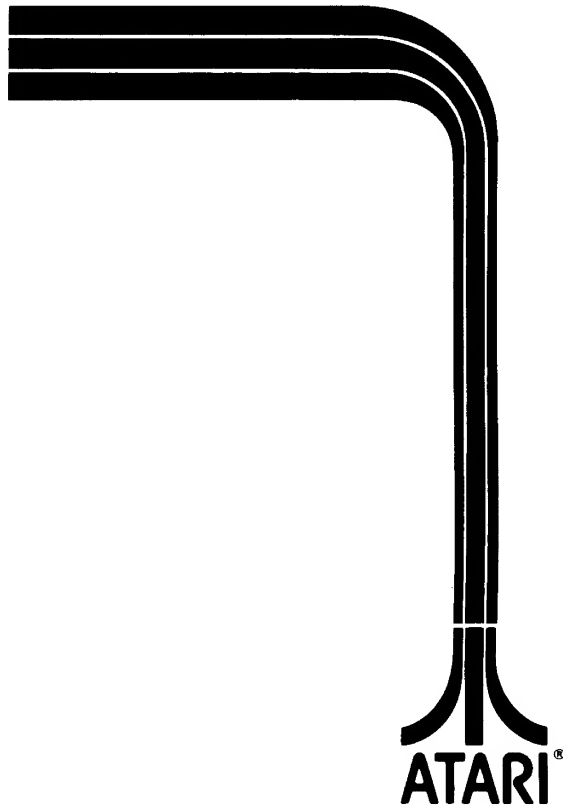




Operation, Maintenance and Service Manual

Complete with Illustrated Parts Catalog

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A Warner Communications Company 

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NOTE

If reading through this manual does not lead to solving a certain maintenance problem, call Tele-Help™ at the Atari Customer Service office in your geographical area, as shown in the two maps below.

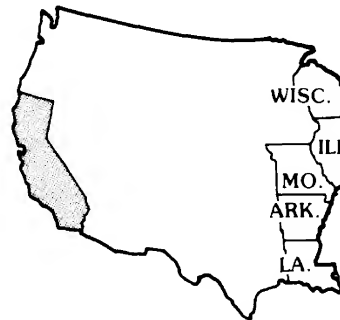
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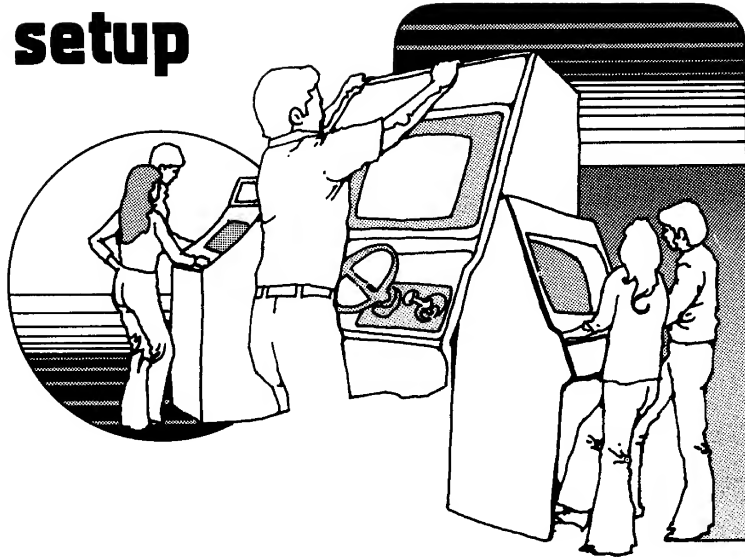
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(Monday - Friday, 8:30 - 5:00 pm Eastern time)

From New Jersey dial
(201) 981-0490

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dial toll-free (800) 631-5374



location setup



a. introduction

Video Pinball™ is a new one- to four-player video game designed by Atari. The pinball action is realistically rendered on the screen such that ball movement is almost exactly that of the mechanical pin games. Gravity effects slow down the ball as it reaches its highest point; then the "slant" of the playfield causes the ball to roll back downwards with increasing speed.

Video Pinball™



Three special features have been included in this game; two of them are new technical developments you may not have dealt with before. The nudge effect of the control panel (see Figure 1-1) very realistically simulates playfield shaking and can let a player “rescue” a ball that might otherwise drain. The effect is accomplished with a conventional leaf switch; the control panel has three springs that hold the panel in the normal position.

The second feature is the special playfield printed circuit board (PCB); mounted on it are 29 light-emitting diodes (LEDs) that simulate the lighted star rollovers, targets, and bonus lights of mechanical pins. If the white video ball passes over an LED, the latter in most cases will light up. Normally, LEDs have an extremely long life expectancy; if you ever have to replace one of them, the procedure is very simple. One of the tests in the self-test procedure causes every LED to light up; thus you can quickly determine if any are burned out.

The third feature of Video Pinball™ is a newly designed mechanical ball shooter. It looks, on the outside, similar to the conventional rubber-tipped mechanical ones but works instead on an opto-electrical principle. Inside it is a small PCB* that includes a photo-sensor. This sensor “sees” when the light beam has been interrupted by a black indicator flag attached to the ball shooter shaft. The photo device also senses and the microcomputer determines at what rate of speed the flag is passing between the two halves of the sensor. This speed is translated by the microcomputer system into a certain degree of force: too little force and the ball will not get out of the ball ramp but will roll back down to the bottom.

The ball shooter assembly should require very little maintenance. Only regular lubrication is needed on the metal shaft. See Figure 3-4 for details on lubricant required.

**Note that this PCB is similar to those used by Atari for several years in almost all of its driving games.*

b. game inspection

Your new Video Pinball™ game is manufactured ready to play immediately after removal from the shipping carton. Your cooperation is desired in order to supply the final touch of quality control to your game. Therefore, please follow the procedures below to ensure that your game is in perfect condition:

1. Examine all external parts of the game cabinet for dents, chips, or broken parts.

1-2 Video Pinball™

2. After determining that the game has been received in good condition, unlock and open the rear access door. Carefully inspect the interior and verify the following:

- a) All plug-in connectors are firmly seated.
- b) Remove game PCB as instructed in steps 2-4 of Section G of this chapter. All integrated circuit packages (chips, ICs) in sockets on the game printed circuit board are firmly seated.
- c) The fuses are all seated snugly in their holders.
- d) No harness wires are disconnected.
- e) No loose foreign objects should be present, especially metal objects that could cause electrical problems.

Be sure all the major assemblies are checked. Check the game printed circuit board (PCB), the transformer (located on the power supply chassis inside the game cabinet), the speaker, and player controls. Also, be certain that the TV monitor is securely mounted.

Note the location of the game’s serial number—it is on the metallic label in the upper left-hand corner on the back of the game cabinet. A serial number (not necessarily the same one) also appears in the corner of the PCB that’s common to both edge connectors, inside the game cabinet. (See the illustration on the inside front cover of this manual.) *Please mention this number(s) whenever calling your distributor for service.*

c. installation requirements

Voltage Selection

Your Video Pinball™ game is shipped for operation at 110 VAC, 60 Hz.

IF YOUR LOCAL LINE VOLTAGE IS 110 VAC, perform the following steps:

1. Measure AC line voltage with an AC voltmeter as shown in Figure 1-2.
2. If AC line voltage is consistently below 100 VAC, plug in the *black* low-voltage connection, on the power supply chassis. See Figure 1-3.
3. If AC line voltage is approximately 110 VAC, plug in the *orange* connection (factory-installed).

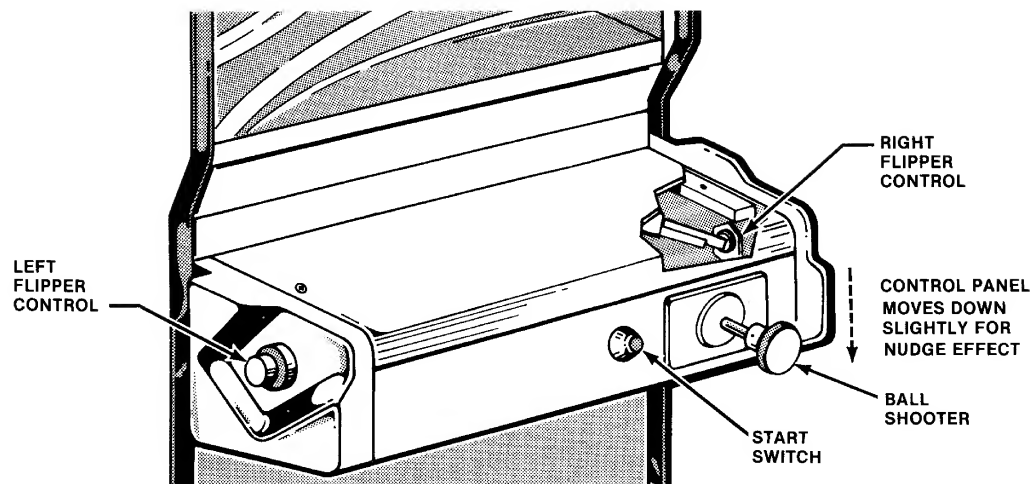


Figure 1-1 Video Pinball™ Control Panel

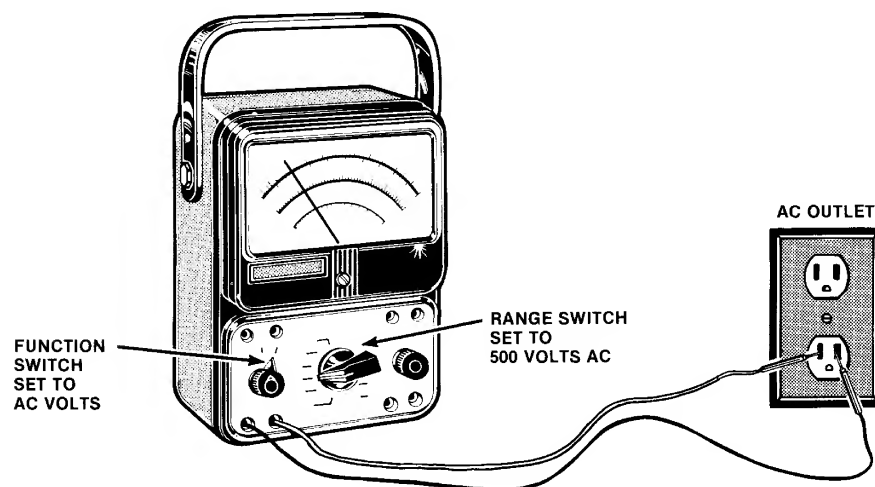


Figure 1-2 AC Line Voltage Check

LINE VOLTAGE	VOLTAGE-SELECTION CONNECTOR WIRE COLOR
95 VAC	BLACK
110 VAC	ORANGE (installed at factory)
210 VAC	GREEN
220 VAC	RED

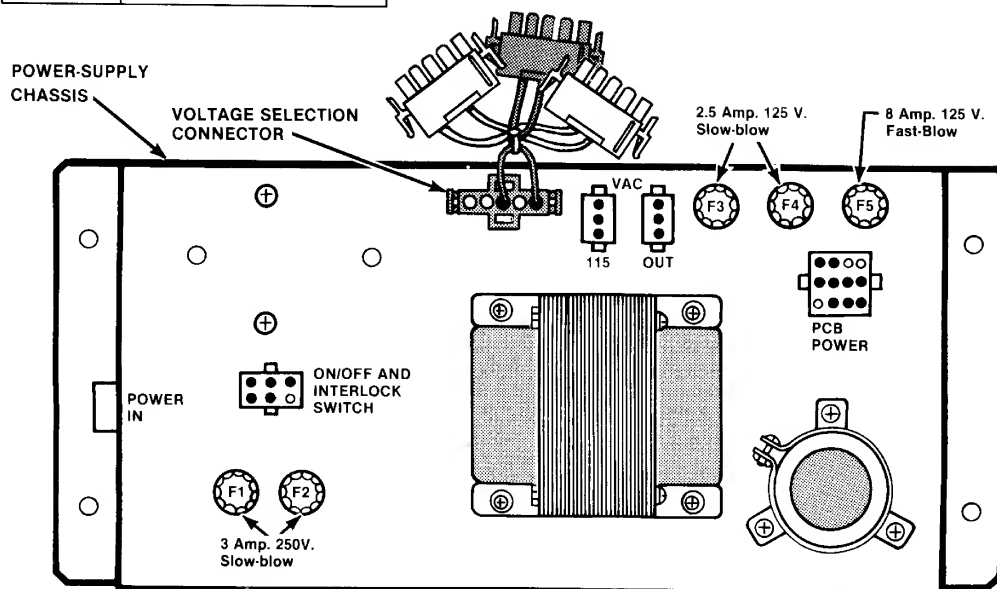


Figure 1-3 Voltage Selection Connectors

IF YOUR LOCAL LINE VOLTAGE IS NOT 110 VAC, BUT INSTEAD IS 220 VAC, perform the following steps:

1. Measure AC line voltage with an AC voltmeter as shown in Figure 1-2.
2. If AC line voltage is consistently below 210 VAC, plug in the *green* low-voltage connection. See Figure 1-3.
3. If AC line voltage is approximately 220 VAC, plug in the *red* connection.

Type of Power Cord

Atari has added a strain-relief cord to your Video Pinball game. The advantage of this type of cord is that if pulled accidentally, the strain-relief will hold the cord in place at the cabinet wall. The plastic strain relief "cushions" the impact of the shock and prevents the cord from pulling the wires out of the harness connector.

Table 1-1 Installation Requirements

POWER REQUIREMENTS	
Power Supply:	110 VAC @ 60 Hz 220 VAC @ 50 Hz
TEMPERATURE RANGE	
On Location and in Storage:	No lower than 0 degrees Celsius (32 degrees Fahrenheit)
HUMIDITY RANGE	
Relative Humidity:	No more than 95%
LOCATION SPACE REQUIREMENTS	
Height:	65 5/8 Inches (166 Centimeters)
Width:	20 1/2 Inches (52 Centimeters)
Depth, incl. Ball Shooter:	40 Inches (102 Centimeters)
TV MONITOR	
	23-Inch Black and White, Wells-Gardner only

1-4 Video Pinball™

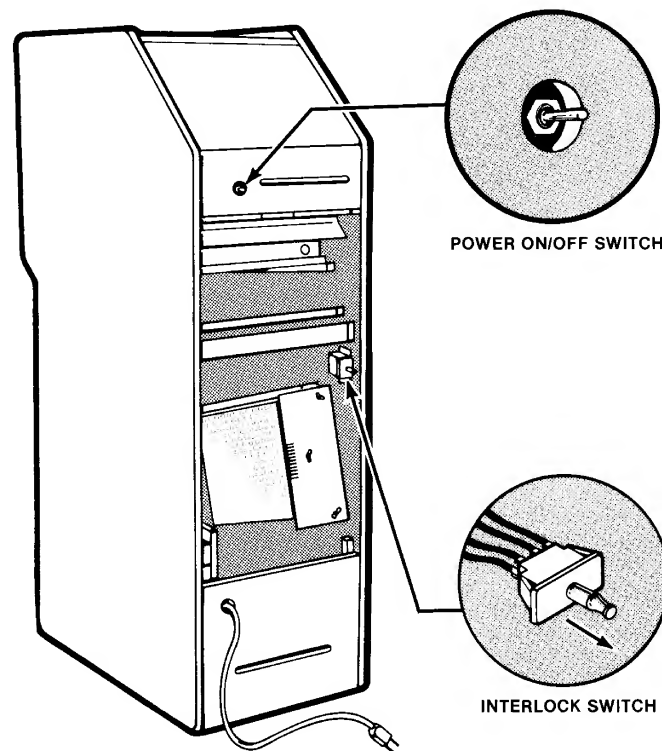
d. interlock and power on/off switch

To minimize the hazard of electrical shock while you are working on the inside of the game cabinet, two interlock switches have been installed. (See Figure 1-4). One is located behind the rear access door and one behind the coin door. These switches remove all the AC line power from the game circuitry while the doors remain open.

Check for proper operation of the interlock switches by performing the following steps:

1. Unlock and open the rear access door and the coin door.
2. Plug the AC line power cord into your local AC outlet (110 VAC or 220 VAC).

3. Set the power On/Off switch to the "On" position.
4. Close the access and coin doors. Within approximately 30 seconds after closing the last door to the game cabinet the TV monitor should display a picture.
5. Slowly open either door to the game cabinet, and the TV picture should disappear when either the rear access door or coin door is opened to approximately one inch.
6. If the results of step 5 are satisfactory, the interlock switches are operating properly. If the picture does not disappear as described, check to see if the corresponding interlock switch is broken from its mounting or stuck in the "On" position.
7. Close and lock both doors.



NOTE:
WHEN TROUBLESHOOTING WITH THE DOOR(S) OPEN, YOU MUST PULL IN-
TERLOCK PLUNGER OUT WITH THUMB AND FOREFINGER AS INDICATED BY
DIRECTION OF ARROW.

Figure 1-4 Location of Interlock and Power On/Off Switches

e. self-test procedure

Video Pinball will test itself and provide data to demonstrate that the game's circuitry and controls are working properly. This procedure uses the TV monitor and the speaker; no additional equipment is required. See Figure 1-5 for location of the Self-Test switch. To start the procedure, slide this switch to "on" as indicated in the figure.

See Table 1-2 for further details and instructions on the Self-Test. We suggest that you run the Self-Test each time the coin box is opened.

f. volume adjustment

If volume is incorrect for your location, open the coin door and adjust the volume control as indicated in Figure 1-5.

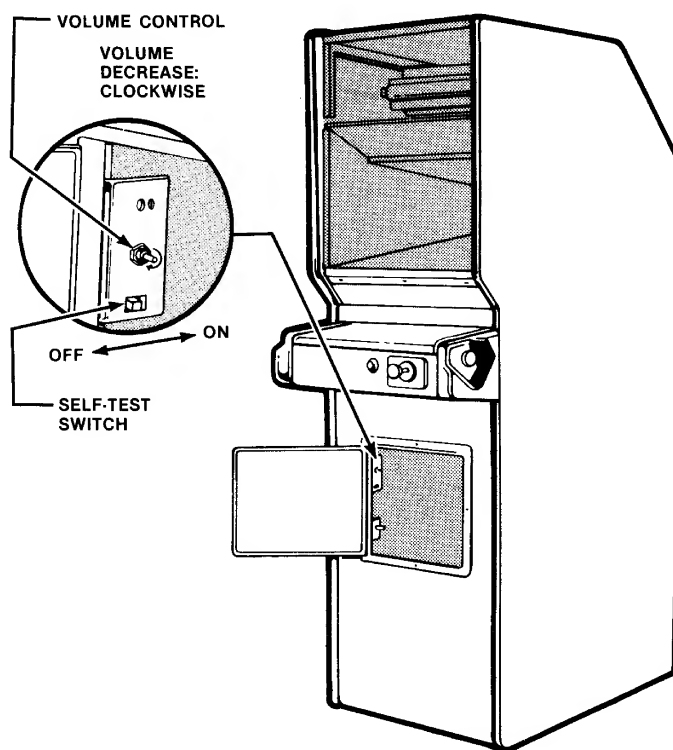


Figure 1-5 Location of Self-Test Switch and Volume Control

Table 1-2 Self-Test Procedure

Instruction	Result if Test Passes	Result if Test Fails
<p>Open coin door and set the self-test slide switch to on or towards rear of the game. Game cycles thru all tests automatically, except as noted.</p> <p>1. RAM TEST</p>	<p>No special message; automatically advances to ROM test.</p>	<p>TV monitor displays a special pattern and a series of 8 tones will sound off (representing D0 thru D7 respectively). In this series, a high note (beep) means that bit was correct; a low note or bong signifies an incorrect data bit.</p> <p>In such a situation this self-test will stop. To re-start, push the self-test switch to off, then on again.</p>
<p>2. ROM TEST</p>	<p>No special message; automatically advances to light test.</p>	<p>Monitor will display ROM 0 1 50 50 as an example. The top line will show any numbers from 0 to 7. These correspond to the eight 1K blocks representing ROMs numbered 0 to 7. In the example above, 0 and 1 mean address 2000 and 2400 are not correct.*</p> <p>The entire self-test procedure will work properly, as long as the highest ROM is functioning (address 3C00 to 3FFF).</p>
<p>3. LIGHT TEST</p>	<p>All lighting in the game will be turned on (or is already on, regardless of whether the game is in self-test). This includes:</p> <ul style="list-style-type: none"> • All 29 LEDs on the playfield display PCB • Start button LED • Fluorescent attraction light • Blacklight tube • Coin door price plate light 	<p>One or more of the lights listed at the left will be off. Check first if that lamp or LED is burned out. Then, if any are still not functioning, check to see if all connectors are secure, if any harness wires are damaged or if the cathode or anode drivers on the game PCB are bad (see page 3-5 for details).</p>
<p>4. SWITCH TEST</p> <p>Push and release each of the following switches:</p> <ul style="list-style-type: none"> • LED start button • Right and left flipper button • Slam switch on coin door • Right and left coin switch • Nudge switch 	<p>Each push and each release will cause a "popping" sound.</p> <p>(MORE)</p>	<p>No sound for any switches means the volume control, the speaker, or its connections should be checked. If only one or a few switches produce no sound, then check the switch for problems.</p>

*For actual part numbers and locations of all ROM (and PROM) chips, see parts list on page 5-21.

Table 1-2 Self-Test Procedure (Continuation)

Instruction	Result if Test Passes	Result if Test Fails
5. BALL SHOOTER TEST Push the plunger in several times, waiting <i>one-half second between plunger activations</i> .	A two-digit hexadecimal number at the bottom center of the screen will be displayed. The minimum speed will be displayed as 00; the maximum is 7F. The slower speeds should produce readings around 30 to 40. Values should be consistent for equal force on the plunger.	TV monitor will display only one two-digit hexadecimal number that never changes, regardless of the speed at which you push the plunger. Check the optical sensing PCB mounted on the ball shooter assembly, the harness wires and connectors. Then check the circuitry on the <i>game PCB</i> that reads photo-electrical input from the optical PCB.
Set the self-test switch to <i>off</i> , or <i>towards you</i> . The following two tests are not part of the game's automatic self-test procedure, but can be done afterwards by the operator to verify the lockout coil, the credit counter and part of the audio.		
Instruction	Result if Test Passes	Result if Test Fails
LOCKOUT COIL AND CREDIT COUNTER TEST Set the self-test switch from <i>on</i> to <i>off</i> . Then press either coin switch.	Tripping the coin switch increments the credit counter by however many digits the coin mode has been set for. (See <i>CREDIT</i> display area in the lower left portion of the TV screen). At the same time a low beep or bong as sounded for each credit. When the credits reach 9, the game will cease to recognize anymore credits, and the lockout coil will be energized to prevent further coins from passing over the coin switches.	Credits will not be recognized and <i>CREDIT</i> display will not be incremented. Also, lockout coil may not be energizing and the game may be accepting more than 9 credits' worth of coins. Check the coin switch, its trip wire and the harness wires. Also, examine the coil and its wiring. If these all check out then the game PCB is at fault.
AUDIO TEST Trip the coin switch several times to register credits. Press the LED start button.	You will hear a low beep or bong sound, as in the previous test, for each tripping of a coin switch. You will hear a high beep or bell sound, up to 4 times (for the 4 players maximum who can play in one game)	No bong sound. Sound generator is probably faulty. No bell sound. Sound generator is probably faulty.
Play the game to insure that the remaining sound circuitry is working properly.		

g. operator options

The operator options offer maximum player appeal for your game location(s). These options are listed in Table 1-3. They are preset for a certain game set-up during production. To determine how the switches have been set for your game, compare the attract mode with the information in Table 1-3, Operator Option Settings.

To change the toggle positions of the switch assembly and set the desired options, the printed circuit board (PCB) must be removed according to the following procedures:

1. Switch the game power on/off switch to "off" and open the rear access door.
2. Locate the radio frequency (RF) shield assembly immediately inside the game cabinet behind the access door (see Figure 1-6). This assembly is an aluminum

box with many small holes. On one end of the assembly is a small PCB with an edge connector coming from the edge of the Video Pinball game PCB.

3. Turn the three individual quarter-turn fasteners on the RF shield PCB $\frac{1}{4}$ -turn to the left or counter-clockwise.
4. Carefully pull out the game PCB and the RF shield board together as a unit. These would not normally need to be separated when merely making option switch changes.
5. Set the switches for the desired options as listed in Table 1-3.
6. Replace both PCBs by following steps 1 through 4 in reverse order. Do not force or bend the game PCB. Before replacing, inspect the PCB for damage.
7. Close and lock the rear access door.
8. Plug in the game and verify that all options function by playing the game.

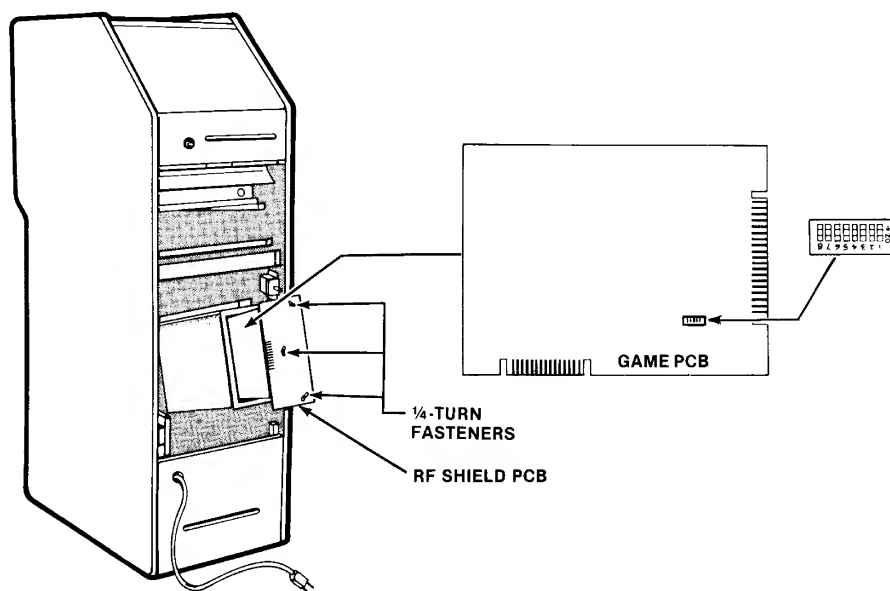
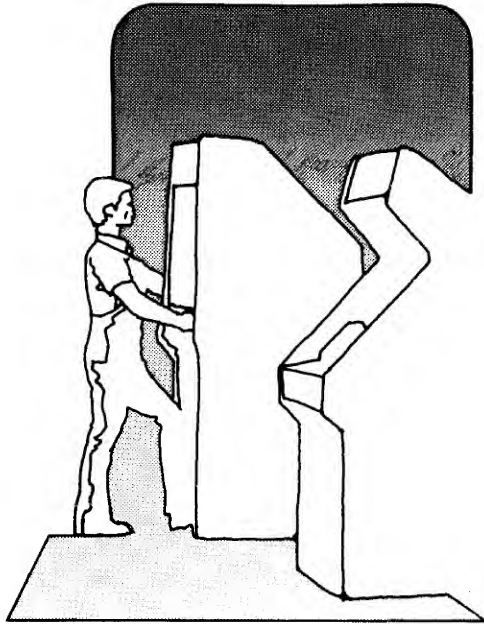


Figure 1-6 Location of Operator Option Switches

**Table 1-3 Operator Option Settings
for Video Pinball™**

Option	Toggle No. of DIP Switch on Game PCB (switch is located at position D7)								Result
	8	7	6	5	4	3	2	1	
Coin Mode	On On Off Off	On Off On Off							Free Play 1 Coin for 2 Players 1 Coin per Player 2 Coins per Player
Game Instruction Language			On On Off Off	On Off On Off					English German French Spanish
Game Length					On Off				5 Balls per Player 3 Balls per Player
Replay Setting						On Off			A special of 1 replay allowed. Match feature on. No replays allowed; a special awards 80,000 points in- stead. No match feature.
Extra Ball Setting							On Off		Extra ball allowed. 50,000 points awarded in- stead of an extra ball.
Points Required to Earn Replay (ignored if switch 3 is off)								On Off	180,000 pts. in 3-ball game 300,000 pts. in 5-ball game 210,000 pts. in 3-ball game 350,000 pts. in 5-ball game



game play

a. introduction

Video Pinball™ has three basic modes of operation: attract, play and self-test. The attract mode is specifically programmed to attract potential players: similar to mechanical pin games, its LED rollovers flash on and off in a repeated sequence.

The play mode begins when the start button is pressed and ends when the last ball that can be played has drained. The self-test is a special procedure that checks for proper functioning of most of the game's circuitry, all the switches, all illumination, the audio, and the ball shooter system.

Video Pinball™



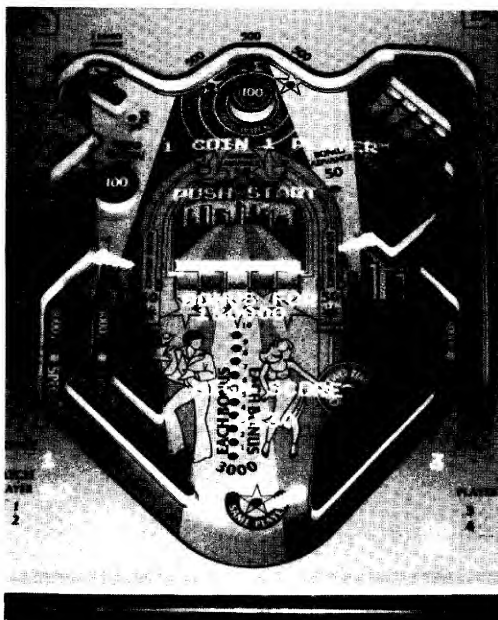


Figure 2-1 Attract Mode Display

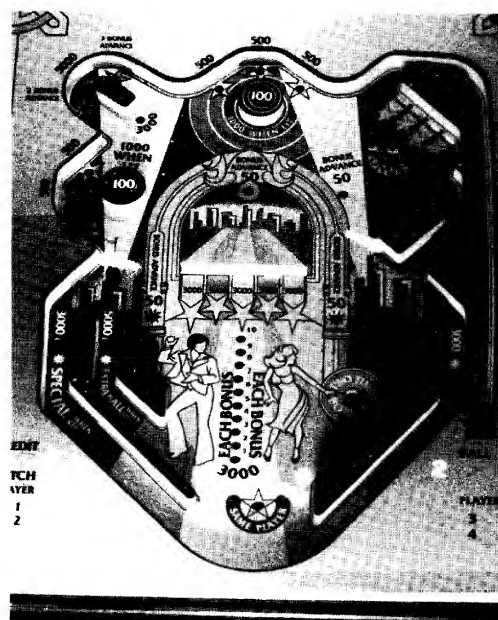


Figure 2-2 Play Mode Display

b. attract mode

The attract mode begins after game power-up, when exiting from the self-test, and after the end of a previous game. The red LEDs in the playfield PCB flash in a repeated sequence to attract the attention of potential players. The coins required per player are displayed, as is the *BONUS FOR*—(points) phrase. (See the replay level settings in Table 1-2, Operator Option Settings, for details on the four possible phrases that could appear.)

After inserting the proper number of coins, the *PRESS START* phrase will appear and flashes. If at least one game has been played since the unit was powered up, then you will also see the phrase *HIGH SCORE* _____ on the screen. This represents the highest game score attained since power was last applied to Video Pinball™ or since the last self-test.

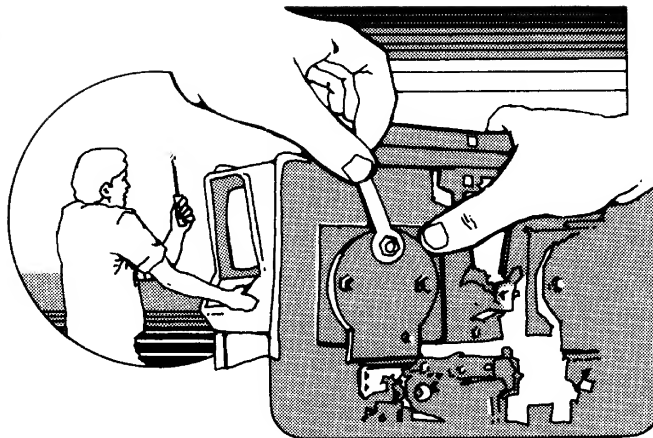
c. play mode

The player(s) now press the start button for the appropriate number of players, and all these phrases disappear. The scoring system is described on the silk-screened Plexiglas shield.

1. Complete lower 5 drop targets once—*EXTRA BALL* light lights up.
2. Complete lower 5 drop targets twice—*SPECIAL* light lights up.
3. Roll over all 5 rollovers—*TWO TIMES BONUS* light lights up.
4. Hit all 3 targets behind either thumper bumper—that thumper lights up.
5. Complete all 4 upper drop targets—bonus advance lights up LED labeled "1". Each subsequent completion of these drop targets increments the series of bonus LEDs to the next number. When bonus #10 has been completed, it stays lit and the sequence continues with 1 thru 9 again, representing bonus #11 thru 19.

Note that the "special" and extra ball are each awarded in two different ways, depending on the option switch settings on the PCB. The special is either one replay or 80,000 points; the extra ball is either exactly that or 50,000 points. See Table 1-2 for details on how to set the switches for these results.

maintenance and adjustments



Due to its solid-state electronic circuitry, this Atari unit should require very little maintenance and only occasional adjustment. Information given in this chapter and elsewhere in this manual is intended to cover most servicing situations that may be encountered at the game site. The procedures given are in sufficient detail to be understood by a person with moderate technical background.

a. cleaning

The exteriors of game cabinets and Plexiglas® panels may be cleaned with any non-abrasive household cleaner. If desired, special coin machine cleaners that leave no residue can be obtained from your distributor. Do *not* dry-wipe the acrylic plastic panels, because any dust can scratch the surface and result in fogging the plastic.

Plexiglas® is a registered trademark of Rohm & Haas Company.

b. fuse replacement

Video Pinball contains seven fuses, five on the power supply assembly in the lower part of the cabinet, and two on the TV monitor assembly. Power supply fuses are accessible through the access door assembly. TV fuses are also accessible through the rear access door. Replace fuses only with the same type as follows:

Wells-Gardner 22V1001 Monitor:

3AG 1.5-amp Slow-blow
3AG 0.75-amp Slow-blow

Power Supply:

Fuses F1 and F2—3AG 3-amp slow-blow, 250 volts
Fuses F3 and F4—3AG 2.5-amp slow-blow, 125 volts
Fuse F5—3AG 8-amp fast-blow, 125 volts

c. control panel access

Prior to replacing either flipper switch or the nudge switch, either flipper button, the LED start switch, the loudspeaker, or any parts of the ball shooter, follow this procedure to gain access to the control panel interior.

1. Remove the screw located at each end of the control panel cover.
2. With slightly moist hands, slide the metal cover towards you about one inch. Lift it up and remove. As an alternate method of removal, you may insert the tip of a screwdriver into either hole, and pull the tool towards you.

Flipper and Nudge Switch Replacement

All three of these leaf switches operate on 5 volts at a very low current. Therefore, pitting of these switches would be extremely rare. Probably the only reason that pitting would occur is in very high humidity locations.

Don't burnish the switches. Burnishing them removes their plating, thus increasing the corrosion of the contacts. *The best method of cleaning the switch contacts is to wipe them with a non-abrasive surface.* A business card works great.

To replace any switch, remove both of its screws with a flat-head screwdriver. See Figure 3-1. (Note: The right flipper switch cannot be removed until you first remove the ball shooter assembly. See Figure 3-4 for instructions.)

If the white flipper button itself needs to be replaced, turn the Palnut with a wrench in a counter-clockwise direction, as seen from the inside of the control panel. The white ring on the outside of the control panel should not spin, due to its design.

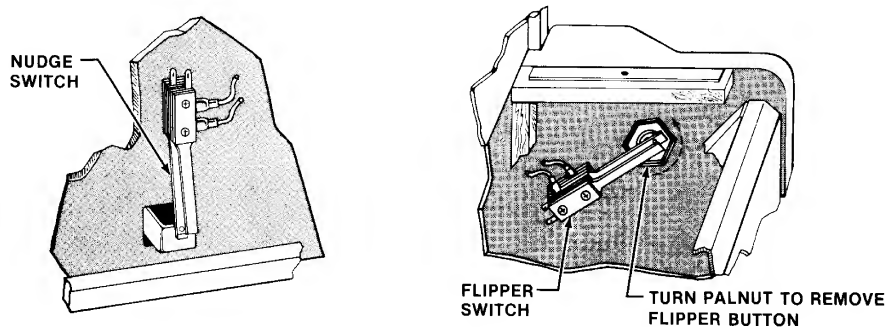


Figure 3-1 Flipper and Nudge Switch Replacement

LED Start Switch Replacement

The LED switch on the front of the control panel has a very low failure rate. In case the switch should ever be suspect, first test it. To test the switch perform the following steps:

1. Remove the wires from the suspected switch.
2. Set multimeter to ohms scale.
3. Set ohms scale to $R \times 1$, then zero the meter.
4. Connect multimeter leads to appropriate LED switch contacts. (See Figure 3-2 for designation of switch contacts and meter lead placement.)

5. Check contacts (push and release the switch button) for closed and open continuity.
6. If the contacts do not operate sharply or always remain closed or open, then replace the LED switch as outlined in Figure 3-2.

Speaker Replacement

If the loudspeaker should ever need to be replaced, removal is very simple. Follow the instructions given in Figure 3-3. Probably the only cause of speaker failure is an electrical short or a ruptured cone, but both of these failure modes are highly unlikely.

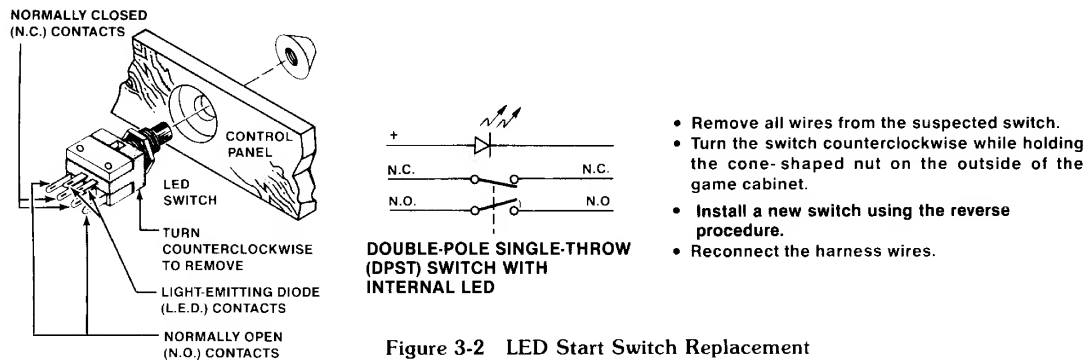


Figure 3-2 LED Start Switch Replacement

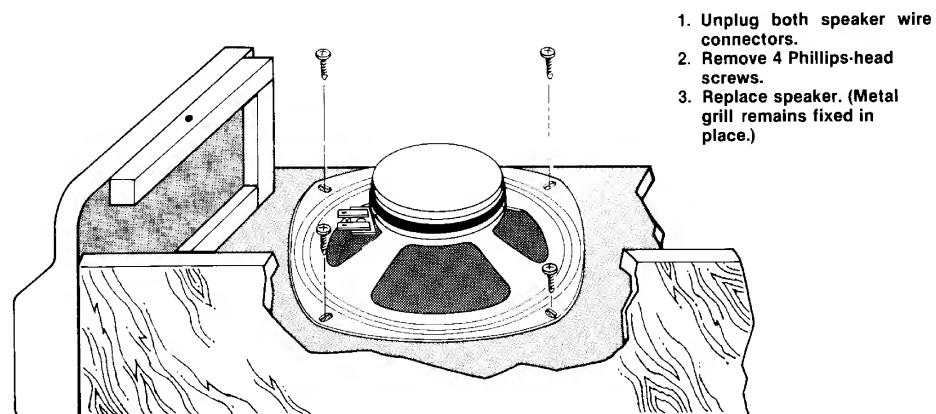


Figure 3-3 Speaker Replacement

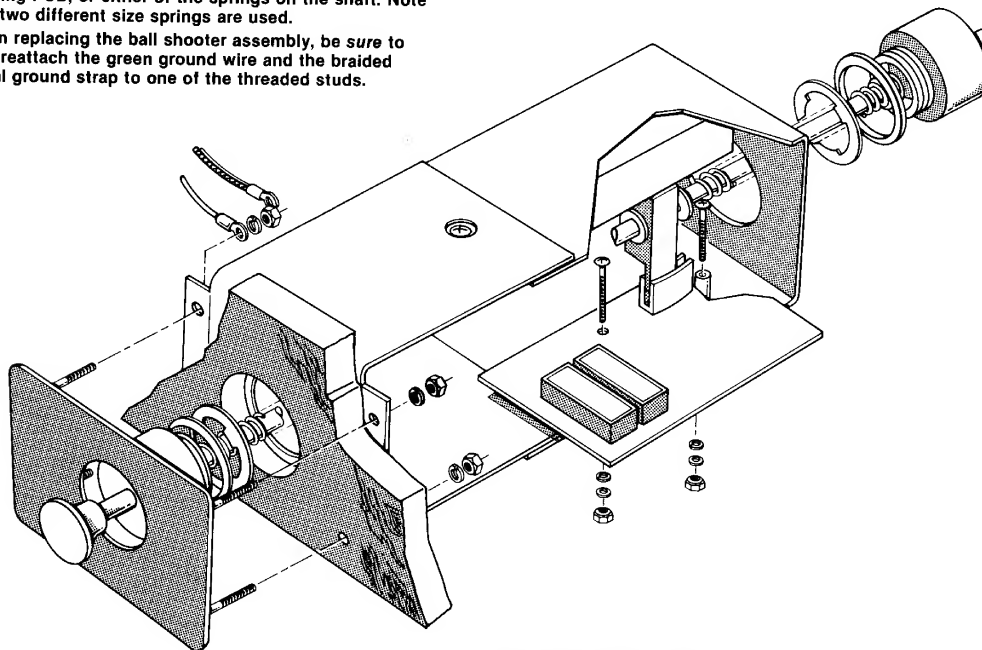
Ball Shooter Maintenance and Repair

Three areas of the ball shooter assembly would possibly need attention: the long metal shaft, the two springs on this shaft, and the optical sensing PCB. Only the shaft needs regular maintenance: lubricate it regularly with a small amount of silicon grease. (For details see Figure 3-4.)

To replace any of these three parts that are faulty, follow the removal instructions given in Figure 3-4. When reinstalling the whole ball shooter assembly, *make certain* that the ground strap and the ground wire are secured to one of the threaded studs on the cover plate. The braided ground strap touches an unpainted portion of the metal control panel cover and is designed to protect players from electrical shock caused by an accidental short circuit in the game.

To replace ball shooter assembly:

1. Unplug Molex connector on optical sensing PCB.
2. Remove hex nuts and lock washers on all four threaded studs inside the ball shooter cover plate.
3. Pull off cover plate completely. Slide ball shooter part-way into square rear access hole in control panel. Then tilt assembly upwards and lift out.
4. You can now replace the ball shooter shaft, the optical sensing PCB, or either of the springs on the shaft. Note that two different size springs are used.
5. When replacing the ball shooter assembly, be sure to also reattach the green ground wire and the braided metal ground strap to one of the threaded studs.



Lubricate the shaft regularly with silicon grease.
Atari part no. 78-1708.

To replace optical sensing PCB:

1. Remove both screws, spacers, and washer sets that hold down the PCB.
2. Remove the printed circuit board. When re-installing a new optical sensing PCB, be sure to carefully align it so that the black "flag" passes between the red sensor's two halves.

Figure 3-4 Ball Shooter Assembly: Maintenance and Replacement

d. white fluorescent light replacement

To replace the white fluorescent tube behind the attraction shield, follow this procedure (see Figure 3-5 below):

1. Remove the two Allen-head screws at the top of the game. They secure the metal retainer for the silk-screened shield. Remove the retainer strip completely.
2. Tilt the top of the Plexiglas shield towards you, then lift it up and out of the bottom retainer strip.
3. Now turn the fluorescent tube one quarter turn in either direction. Remove and replace with a new tube. Close up the game by following these instructions in reverse order.

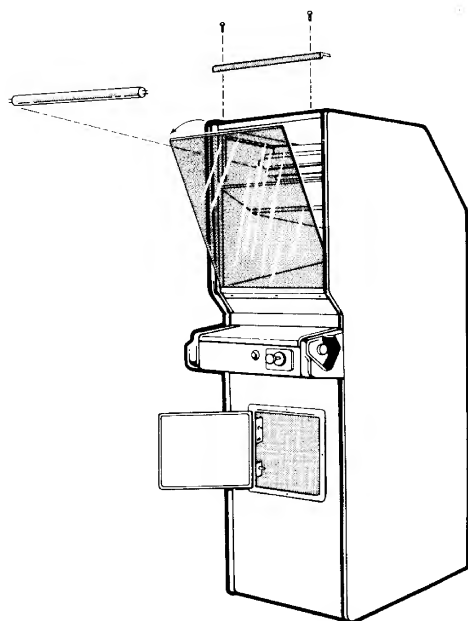
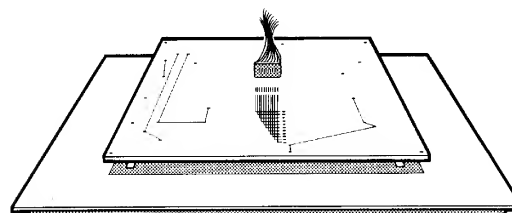


Figure 3-5 Fluorescent Light Replacement

e. playfield pcb repair

Figure 3-6 describes the procedure for repairing this board, namely replacing individual light-emitting diodes. Although LEDs have an extremely long life expectancy once burned in, it may still be necessary to replace some of them.

However, if several LEDs “burn out” at once, check to see if they fall into any special grouping. The schematic in Figure 4-16 shows that if several LEDs are out, the cathode or anode drivers on the game PCB could be faulty. Six or eight LEDs out generally means one of the cathode drivers is bad; three or four LEDs burned out may mean a bad anode driver.



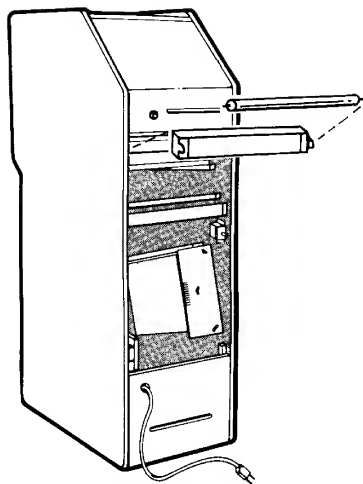
1. Remove Plexiglas[®] shield.
2. Disconnect the connector in the center of the PCB. Carefully lift up the board out of the holes in the playfield. You will be removing the board by pulling apart the four “hook and loop” fasteners.
3. Unsolder any burned out LEDs (light-emitting diodes) and replace them with new ones.
4. Replace the PCB by aligning the red light-emitting diodes in their appropriate holes. Press down gently on the four fastener areas.
5. Reconnect the PCB connector. Make sure the blank position in it (appears as a “missing” wire) is at the right end of the connector.
6. Replace the Plexiglas shield and its retainer strip.

Plexiglas[®] is a registered trademark of Rohm and Haas Company.

Figure 3-6 Playfield PCB Replacement

f. blacklight replacement

If the blacklight tube burns out, replace it with the same length of tube. Follow the replacement procedure given in Figure 3-7.



To replace a burned-out blacklight tube:

1. Remove the rear access door to the game. Bend up flap of playfield cardboard at the perforation. You do not need to remove staples from the cardboard.
2. Turn the blacklight tube $\frac{1}{4}$ turn towards or away from you. Lift it up slightly, and then out.
3. Replace with a new blacklight tube of the same rating and length.
4. Close the rear access door to the game.

Figure 3-7 Blacklight Replacement

g. tv monitor removal

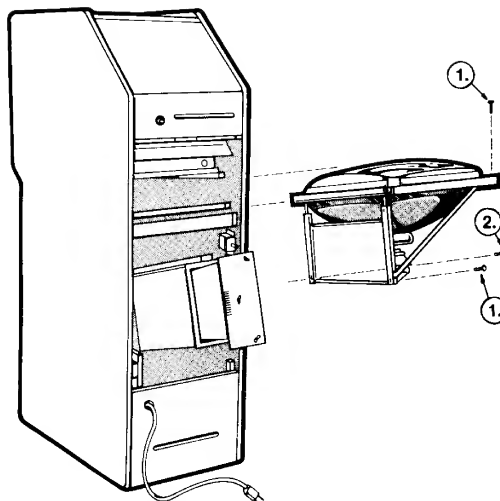
If the television monitor is faulty in any way, you will need to remove it for servicing. Follow the procedure given in Figure 3-8. The monitor can then be set on a test bench for much easier access.

Note that the usual picture adjustments can still be done with the TV installed. Refer to the Wells-Gardner service manual that came with your game for complete details on adjustments and servicing of this monitor.

h. nudge spring replacement

Tools required: 5/16" nut driver or socket wrench (ratchet-type)
5/32" Allen wrench

1. Remove the front Plexiglas shield by first removing the metal retainer strip at the top of the game.
2. Remove the silk-screened cover on the control panel.
3. Remove the blacklight fixture at the back of the game. Shove the half-silvered mirror backwards about 6 inches.



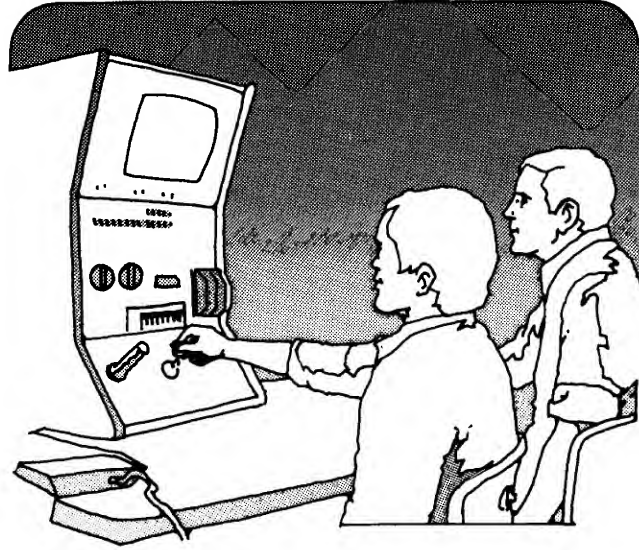
NOTE: In the Video Pinball™ game, the Wells-Gardner brand of 23" TV monitor is used exclusively.

1. Remove rear access door. Remove the 2 screws from the rear.
2. Open the coin door. Remove this screw by reaching through the coin door.
3. Disconnect the Molex connector on the rear of the TV chassis. Then disconnect the connectors on the main harness and the blacklight harness.
4. Carefully slide out the monitor, making sure not to touch the yoke area. *High voltages present at the rear of the tube can be fatal.* Replace the monitor by following instructions in reverse order.

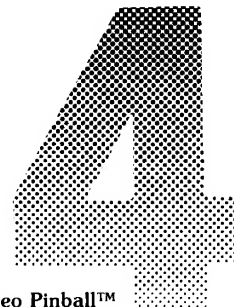
Figure 3-8 TV Monitor Removal

4. Disconnect the white Molex connector behind and slightly below the control panel.
5. Now remove the nuts and washers from the 3 hex-socket shoulder screws at the bottom back of the control panel. The nuts on these 3 screws should be the first thing off, and the first on. The nudge springs are on these shoulder screws.
6. Remove the top 4 carriage bolts and nuts, while supporting the control panel with your hip.
7. When replacing the control panel, thread the Molex connector through the small rectangular hole. Be sure the harness wires are not trapped on either a carriage bolt or shoulder screw next to the hole. Install all seven nuts and washers. Tighten the carriage bolts *first*, then the shoulder screws. Be sure nudge switch can be activated and is not closed when control panel is at rest. When done, the control panel and front of the game should be parallel.

details of electronic operation



The following information provides a detailed description of the game PCB. With this information we provide block diagrams of many of the circuits. In the block diagrams we have, for the most part, used the same blocks in which we divided the schematic diagrams. We hope that this will aid you in identifying the actual functions of the circuitry.



Video Pinball™

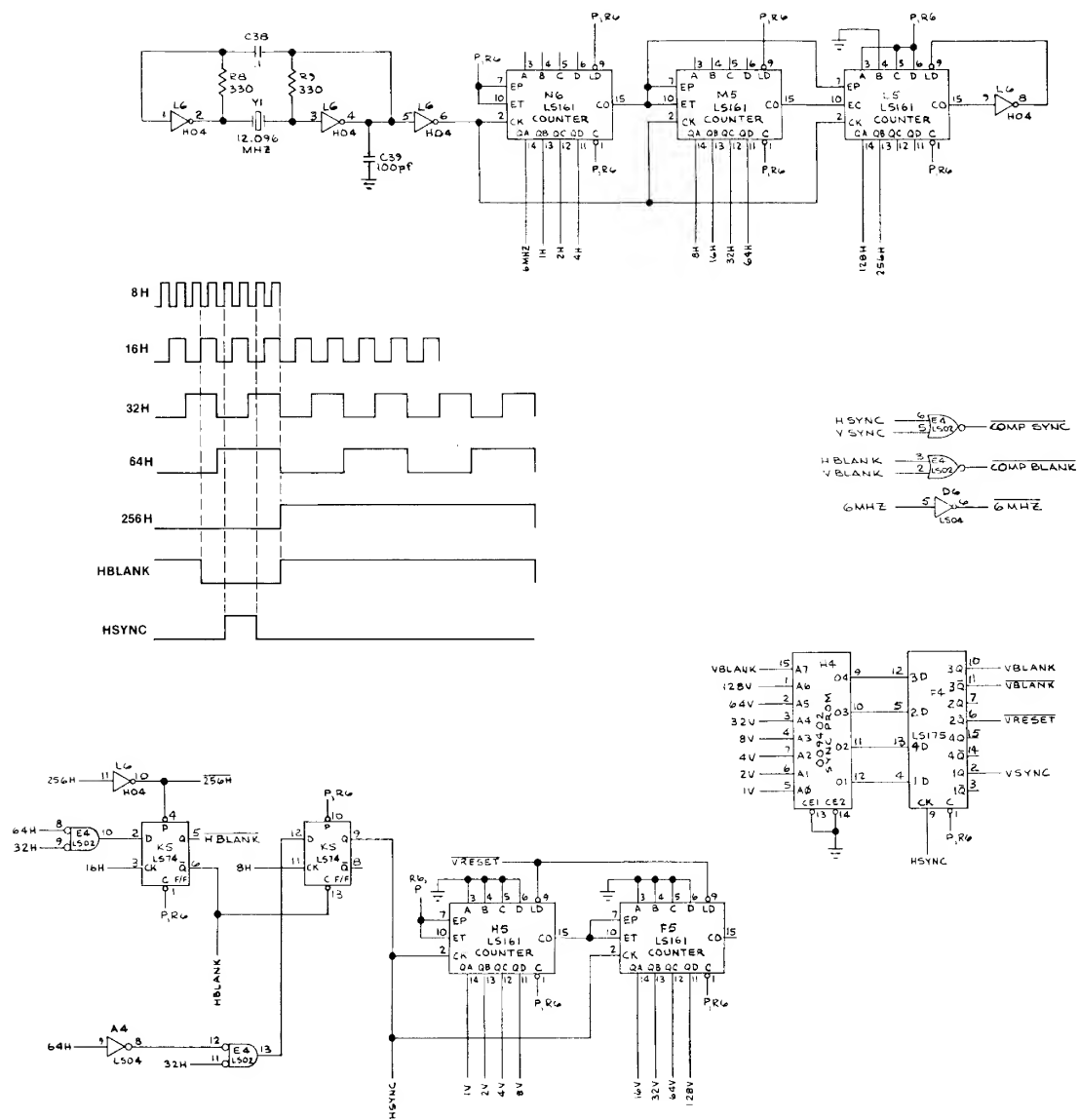


Figure 4-4 Sync Schematic Diagram
(Part of Game PCB 030845-XX A)

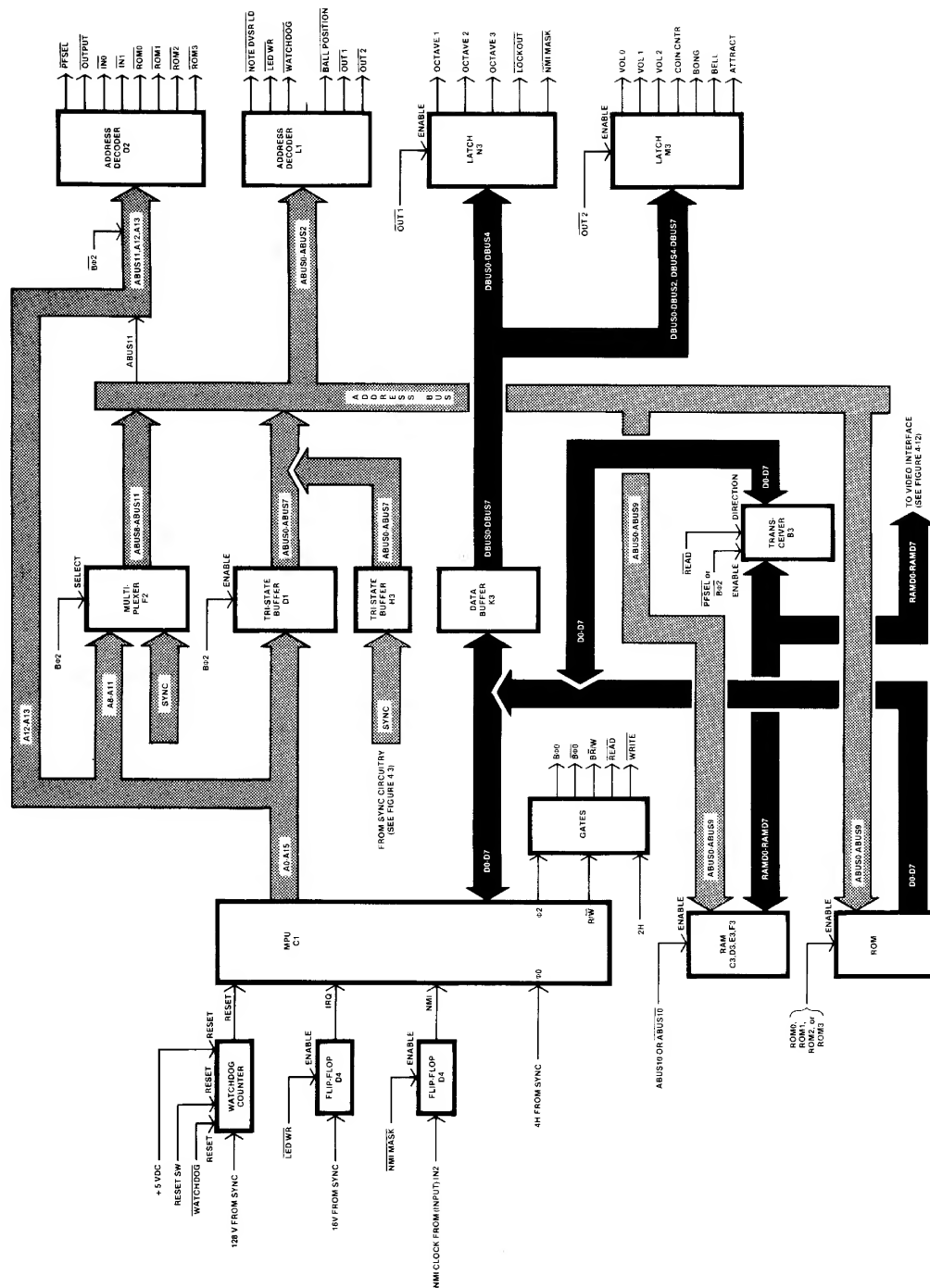


Figure 4-5 MPU Circuitry

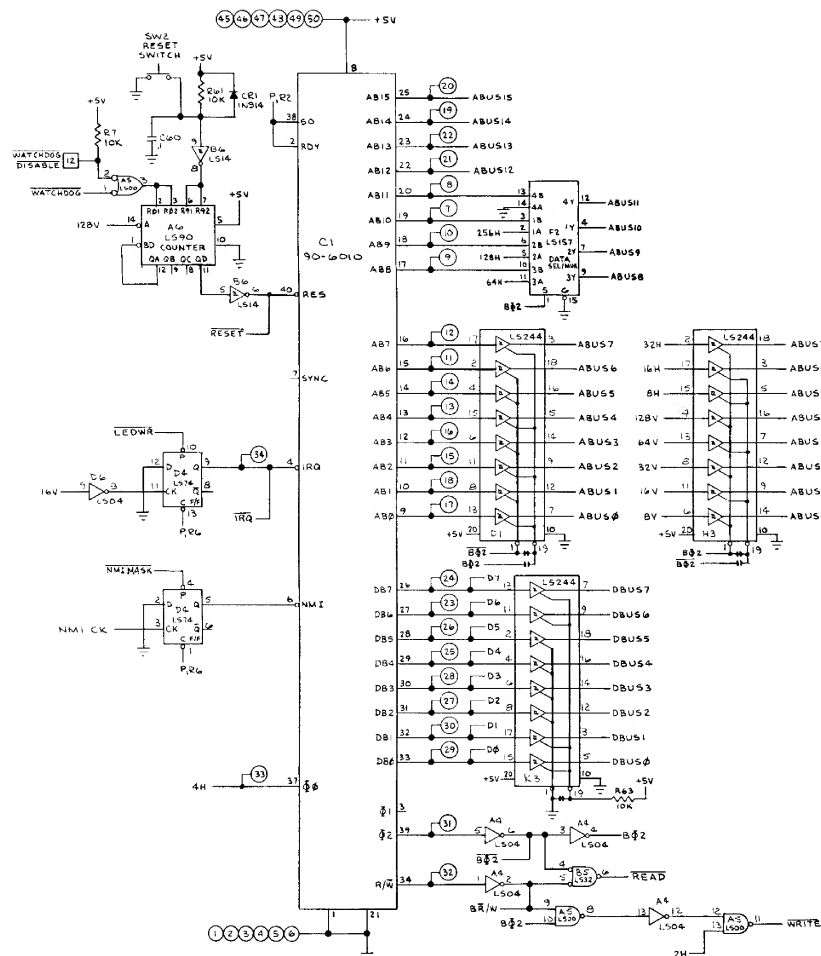


Figure 4-6 MPU Schematic Diagram
(Part of Game PCB 030845-XX A)

c. microprocessor circuitry

MPU (Microprocessor)

(See Figures 4-5 and 4-6)

The MPU, at location C1, controls the game play. This device outputs addresses, reads data instructions, stores data in the RAM (random-access memory), reads previously stored data from the RAM, reads switches and writes to the playfield video, playfield LEDs and audio circuitry.

$\Phi 0$ (phase 0), RESET, NMI, and IRQ are the controll-

ing input signals to the MPU which determine its timing, initialization, and "interrupt" status.

The MPU receives 4H from the Sync Circuitry, conditions the signal and outputs the $\Phi 2$ clock signal that is critical to the synchronization of the MPU support circuitry.

The RES signal forces the MPU to reinitialize the system when power is initially applied to the game, if RESET SWITCH SW2 is pressed, or if a program malfunction occurs (when the MPU fails to output a WATCHDOG address before counter A6 reaches the count of eight).

The IRQ (interrupt request) pulse input to the MPU is received by the MPU 8 times per frame. When the IRQ pulse is received, the MPU responds by enabling the playfield LEDs, then writing new data to them.

The small ball shooter PCB generates an NMI clock signal. This NMI clock results in the MPU receiving a non-maskable interrupt. The MPU then interrupts its ongoing routine to read the ball shooter.

Address Decoder

(See Figures 4-5 and 4-7)

The Address Decoder enables certain sections of game circuitry (i.e., RAM, program memory, playfield LEDs, etc.) when addressed by the MPU. When enabled, data is transferred between that game circuitry and the MPU.

Table 4-1 is the memory map for the Video Pinball game. The memory map shows which section of the game circuitry is enabled by a particular address. Note that the address is given in both hexadecimal and binary numbers. In the binary column, an X indicates that it makes no difference whether that address line is high or low. The address lines necessary to select a given output of the address decoder is indicated with ones and zeros. The actual address lines that are used to address the

selected game circuitry are indicated by As (plural of A). The R/W column shows that when WRITE (designated by W) is low, the MPU is writing to the selected circuitry. When READ is low, the MPU is reading the selected circuitry. The data column shows the data lines (each used data line is indicated by a D) used in the read or write operation. The function column defines the purpose of the read or write operation.

The Address Decoder consists of two decoders, D2 and L1. Decoder D2, driven by address lines ABUS11 thru ABUS13, is enabled by $B\Phi 2$. Output signal PFSEL (playfield select) enables the RAM memory; OUTPUT is gated with both READ and WRITE, so that either an MPU input operation or an MPU output operation can occur on this address decode. During the READ cycle of this address decode, the MPU recognizes the PLUNGER, NUDGE, or VLANK inputs. IN0 (input zero) enables the reading of player switches; IN1 (input 1) enables the reading of game option switches; and ROM0 thru ROM3 enables the reading of program memory.

Address Decoder L1, driven by address lines ABUS0 thru ABUS2, is selected during the MPU's write operation and is enabled by the gating of WRITE and OUTPUT signals. When both are low, Decoder L1 is enabled for a decode output.

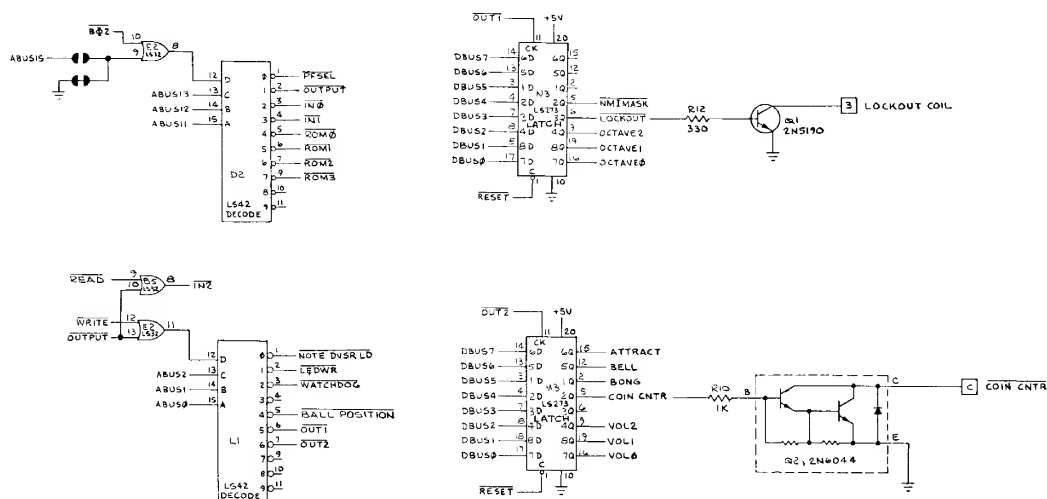


Figure 4-7 Address Decoder and Data Enables Schematic Diagram
(Part of Game PCB 030845-XX A)

**Table 4-1 Memory Map of Video Pinball™
A033268-01 A**

hexadecimal	ADDRESS																DATA	FUNCTION/SIGNAL
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
0000-01FF	X	X	X	0	0	0	0	X	X	A	A	A	A	A	A	X	write or read working RAM	
0200-7FF	X	X	X	0	0	0	0	0	A	A	A	A	A	A	A	X	write to playfield RAM	
0800	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	R	load audio frequency load (NOTE DVSR/LD)	
0800	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	R	V BLANK read (V BLANK)	
0800	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	R	nudge switch read (NUDGE)	
0800	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	R	plunger flag (PLUNGER 2)	
0800	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	R	plunger flag (PLUNGER 1)	
0801	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	W	LED write (LED WR)	
0802	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	W	watchdog counter clear (WATCHDOG)	
0804	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	W	video ball position (BALL POSITION)	
0805	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	W	NMI MASK (OUT 1)	
0805	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	W	lockout coil (OUT 1)	
0805	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	W	audio frequency (OUT 1)	
0806	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	W	audio disable during attract (OUT 2)	
0806	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	W	bell audio gen. enable (OUT 2)	
0806	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	W	bong audio gen. enable (OUT 2)	
0806	X	X	X	0	0	1	X	X	X	X	X	X	X	X	X	W	coin counter (OUT 2)	
1000	X	X	X	0	1	0	X	X	X	X	X	X	X	X	X	W	audio volume select (OUT 2)	
1000	X	X	X	0	1	0	X	X	X	X	X	X	X	X	X	W	test switch read (IN0)	
1000	X	X	X	0	1	0	X	X	X	X	X	X	X	X	X	W	slam switch read (IN0)	
1000	X	X	X	0	1	0	X	X	X	X	X	X	X	X	X	R	start switch read (IN0)	
1000	X	X	X	0	1	0	X	X	X	X	X	X	X	X	X	R	right flipper switch read (IN0)	
1000	X	X	X	0	1	0	X	X	X	X	X	X	X	X	X	R	left flipper switch read (IN0)	
1000	X	X	X	0	1	0	X	X	X	X	X	X	X	X	X	R	left coin (2) switch read (IN0)	
1800	X	X	X	0	1	1	X	X	X	X	X	X	X	X	X	R	right coin (1) switch read (IN0)	
1800	X	X	X	0	1	1	X	X	X	X	X	X	X	X	X	R	coin mode 1 read (IN1)	
1800	X	X	X	0	1	1	X	X	X	X	X	X	X	X	X	R	coin mode 0 read (IN1)	
1800	X	X	X	0	1	1	X	X	X	X	X	X	X	X	X	R	language 1 read (IN1)	
1800	X	X	X	0	1	1	X	X	X	X	X	X	X	X	X	R	language 0 read (IN1)	
1800	X	X	X	0	1	1	X	X	X	X	X	X	X	X	X	R	3/5 ball read (IN1)	
1800	X	X	X	0	1	1	X	X	X	X	X	X	X	X	X	R	free game read (IN1)	
1800	X	X	X	0	1	1	X	X	X	X	X	X	X	X	X	R	extra balls read (IN1)	
2000-27FF	X	X	X	0	1	1	X	X	X	X	X	X	X	X	X	R	replay level (IN1)	
2800-2FFF	X	X	1	0	0	A	A	A	A	A	A	A	A	A	A	R	read program ROM 0, 1	
3000-37FF	X	X	1	1	0	A	A	A	A	A	A	A	A	A	A	R	read program ROM 2, 3	
3800-3FFF	X	X	1	1	1	A	A	A	A	A	A	A	A	A	A	R	read program ROM 4, 5	
	X	X	1	1	1	A	A	A	A	A	A	A	A	A	A	R	read program ROM 6, 7	

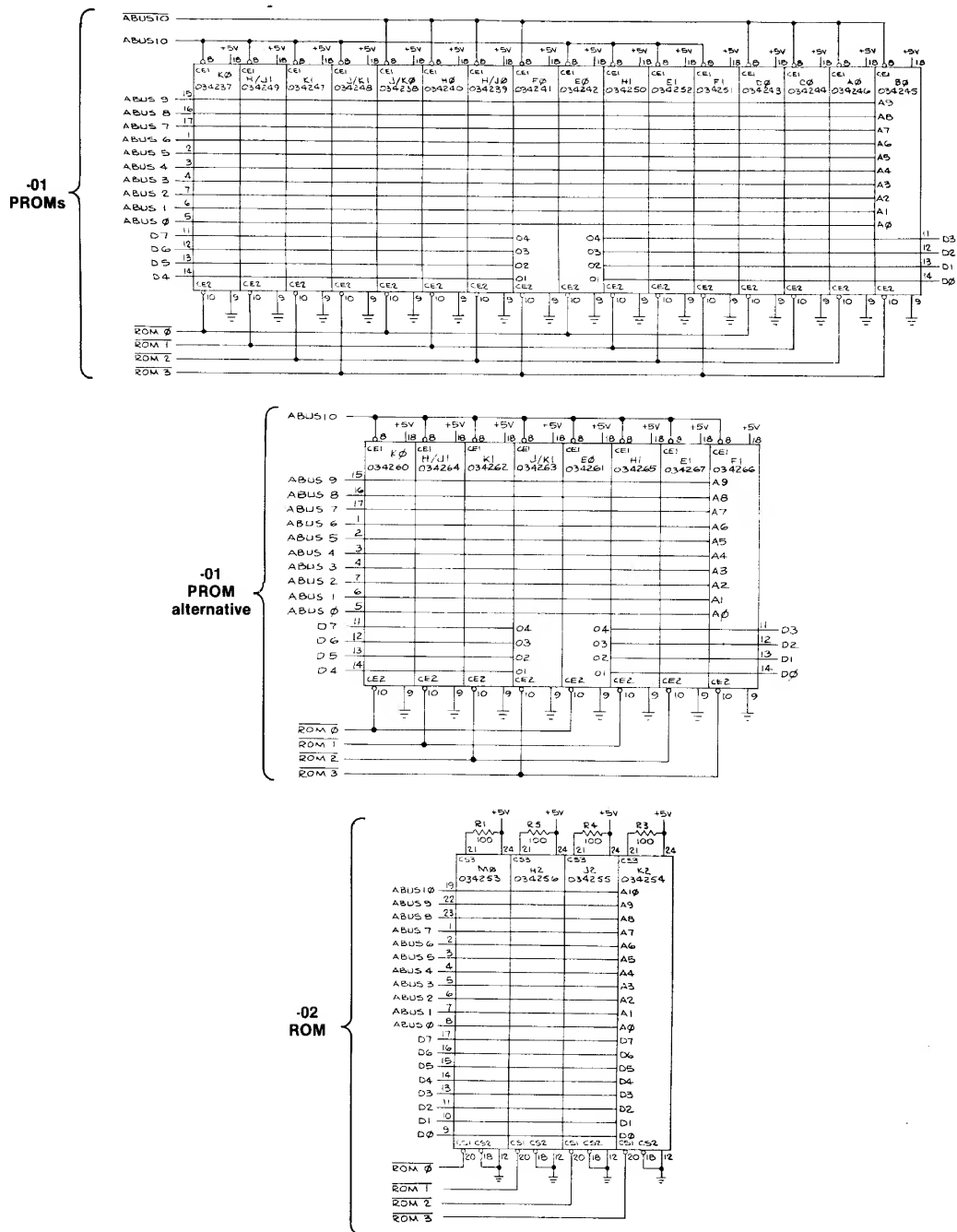


Figure 4-8 ROM Memory Schematic Diagram
(Part of Game PCB 030845-XX A)

Video Summer

The playfield and ball video is summed at the input of OR gate B5 and clocked through flip-flop E6 at a 6MHz rate. Composite sync COMP SYNC is summed with the video picture at the output of flip-flop E6.

The signal NOTE DVSR LD (note divisor load) loads new data into the frequency select register of the audio circuitry; LEDWR (LED write) clocks data into the LED selection circuit; WATCHDOG resets the watchdog counter; BALL POSITION (ball position load) loads ball position data into the ball position counters; OUT1 clocks data from MPU that permits the NMI (non-maskable interrupt of the MPU) to occur, activates the coin door lockout coil and selects the octave in the audio circuitry; OUT2 clocks the data from the MPU that turns off the sound during the attract mode, turns on the bell sound, turns on the bong sound, advances the coin door coin counter and selects the volume of the sound output.

Program Memory

(See Figures 4-5 and 4-8)

Program memory consists of either four ROMs (read-only memory), ROM0 thru ROM3; sixteen PROMs (programmable read-only memory), PROM1 thru PROM16; or eight PROMs, PROM1 thru PROM8.

When we begin the production of a new video game, we generally program our own memory (PROMs). After the first few weeks of production, we begin installing ROM memory in our games. Therefore, when you

received this game, you may have either sixteen PROMs, eight PROMs, or four ROMs for program memory. In fact, it is even possible to have a combination of both ROMs and one or the other set of PROMs in your game. See page 5-21 in the Illustrated Parts Catalog of this manual for ROM/PROM equivalent and part number information.

If a PROM fails, don't order a replacement PROM before checking with our customer service people. It might be cheaper to replace that PROM, or set of PROMs, with a ROM.

The program memory is a sequence of instructions which tell the MPU how to run the game play, video display and associated hardware. Each ROM or equivalent set of PROMs are individually enabled by the address decoder. In addition to address decoder enabling, the eight-PROM set is also enabled by ABUS10 from the microprocessor, while half of the sixteen-PROM set is enabled by ABUS10, and the other half by ABUS10.

RAM

(See Figures 4-5 and 4-9)

The function of the RAM is to act as a storage medium, or temporary storage space, for the information that the MPU decides it wants to save, and then later recall. RAM C3 and F3 is the location of Page 0 thru Page 3 RAM. Additional RAM at location D3 and E3 is used specifically for storing playfield information. These are enabled by address signal ABUS10.

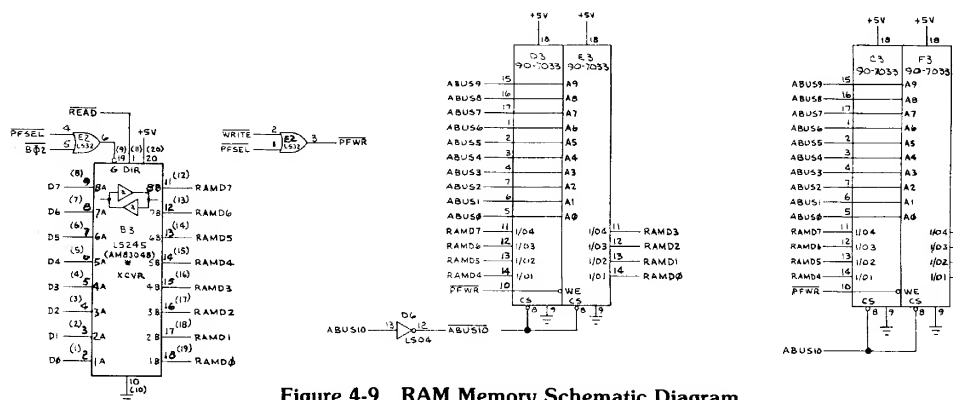


Figure 4-9 RAM Memory Schematic Diagram
(Part of Game PCB 030845-XX A)

d. switch input circuitry

(See Figures 4-10 and 4-11)

The switch input circuitry is controlled by three individual enabling signals. Two of these signals, $\overline{IN0}$ and $\overline{IN1}$, are the results of decoded address signals from the address decoder D2. The third signal, $\overline{IN2}$, is derived from gating \overline{READ} signal from the MPU and the \overline{OUTPUT} signal from the address decoder D2. $\overline{IN0}$ enables the reading of the player controlled switches. $\overline{IN1}$ enables the reading of the game option switches. $\overline{IN2}$ enables the reading of the PLUNGER inputs, the NUDGE input, and VBLANK.

The plunger of the ball shooter has a black piece of plastic (flag) attached to it. When the plunger flag passes

between the first section of the optical coupler (see inset of Figure 4-11), the MPU receives a non-maskable interrupt. When the flag passes between the second section of the optical coupler, the MPU calculates the time between the PLUNGER 1 and PLUNGER 2 signals received. This results in the MPU displaying the ball being shot onto the playfield at a certain speed.

Please note that for the three switch input buffer chips at A7, B7; and C7 there may be either a 74LS244 or a 74LS241 in these locations. As you can see on the schematic diagram, there are solder pads and inverters for inverting the logic of the 2G enable. If 74LS241s are used in these positions, the solder pad shown shorted on the schematic is open and the solder pad at the outputs of the inverters is shorted.

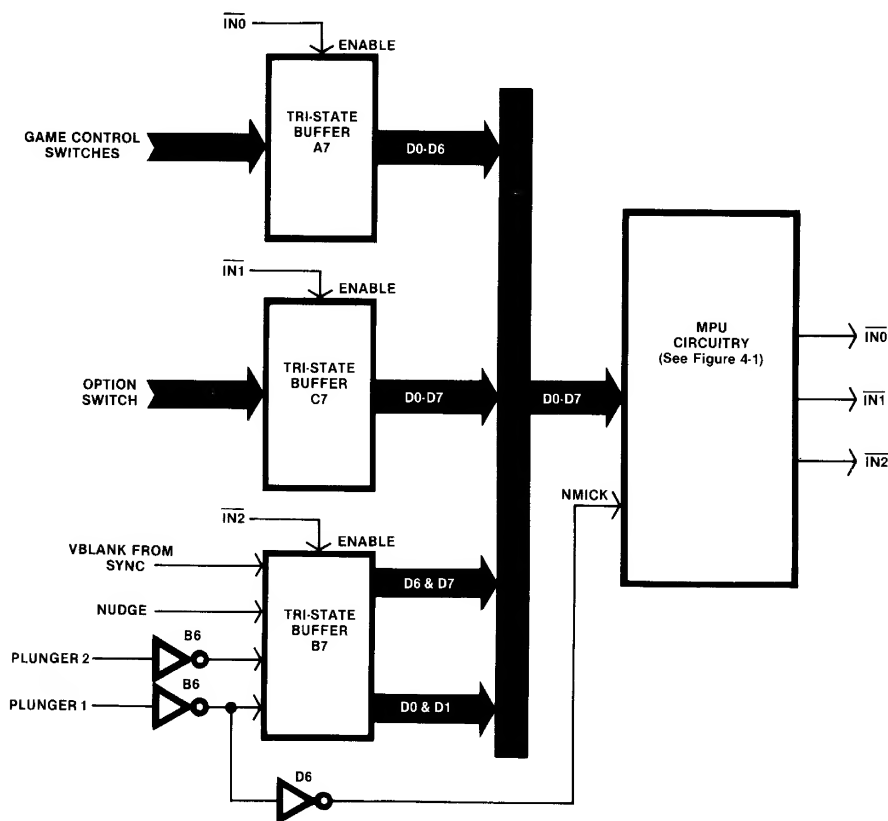
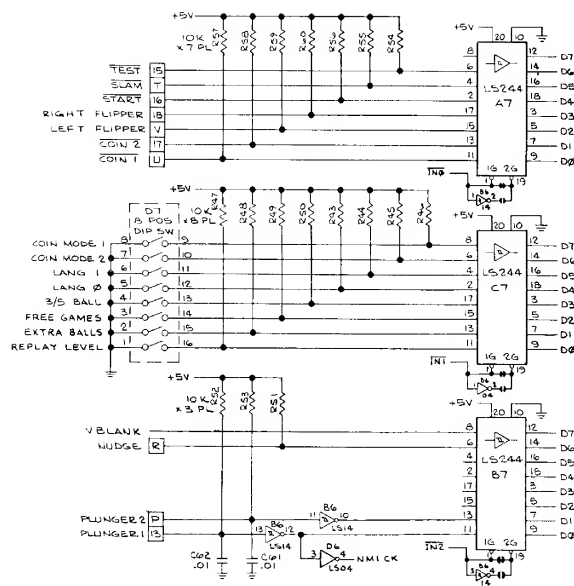


Figure 4-10 Switch Input Circuitry
(Part of Game PCB 030845-XX A)



STEERING BOARD 009060-03 B

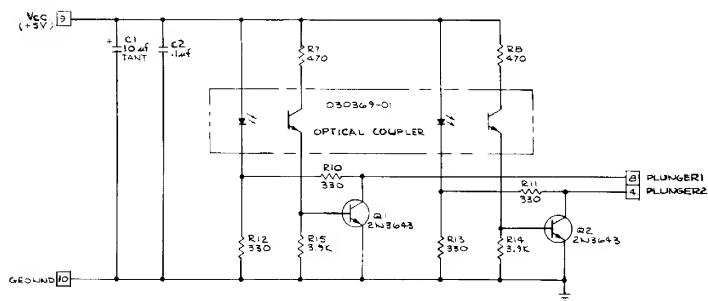


Figure 4-11 Switch Input Schematic Diagram
(Part of Game PCB 030845-XX A)

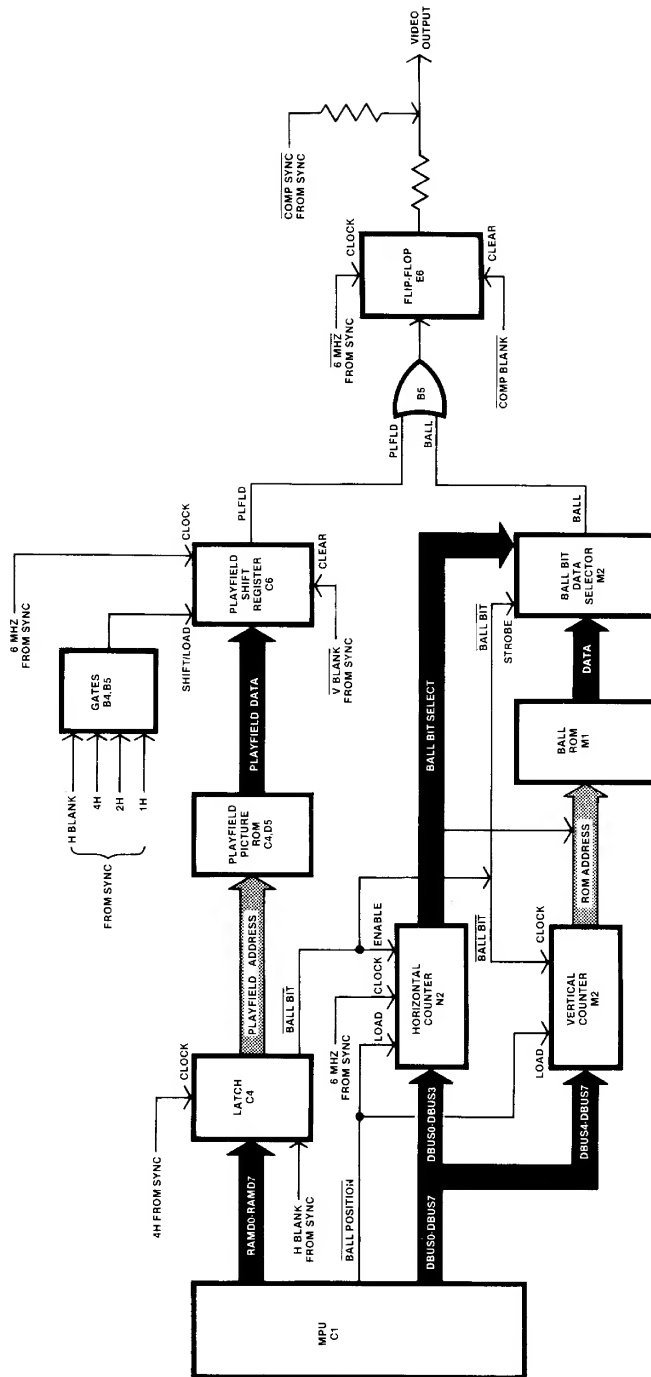


Figure 4-12 Video Interface Circuitry
(Part of Game PCB 030845-XX A)

e. video interface circuitry

(See Figure 4-12 and 4-13)

There are two sections of the video circuit. The playfield circuit produces the flippers, drop targets, thumper bumper lights, and all video messages. The ball circuit produces the ball image.

Playfield Circuit

Playfield video is produced by a process known as DMA (direct memory access). DMA is a term used to describe the circuitry, peripheral to the MPU, which temporarily takes control of the address and data bus to gain direct access to a portion of the MPU's RAM memory.

The MPU stores data into the playfield RAM during the write cycle ($\overline{B\Phi 2}$ and \overline{WRITE} are both low). When $\overline{B\Phi 2}$ goes high, the DMA addresses the playfield RAM with horizontal and vertical sync signals (see chips F2 and H3

in Figure 4-6). In other words, the MPU writes information into the RAM that defines the playfield picture, then sync extracts the information from the RAM at the time it is actually displayed.

The monitor display is subdivided into small rectangles called "stamps". Each "stamp" is eight bits wide by eight lines high. Stamps are a convenient way for the MPU to assemble a playfield picture with a minimum of data.

The playfield circuit, when clocked by horizontal sync component 4H, latches the RAM data at the output of C4. Five bits of the latched data directly address the playfield picture ROMs C5 and D5. Vertical sync components 1V, 2V and 4V are Exclusive ORed with 2Q of latch C4. The outputs of the three Exclusive ORs become the three lower-order address inputs of the playfield picture ROMs. If RAM D6 is high, then these Exclusive ORs invert 1V, 2V and 4V, and the stamp is read out upside down. If RAM D6 is low, 1V, 2V, and 4V are not inverted, and the stamp is scanned in its normal sequence. Therefore, the six RAM data bits RAMD0 thru

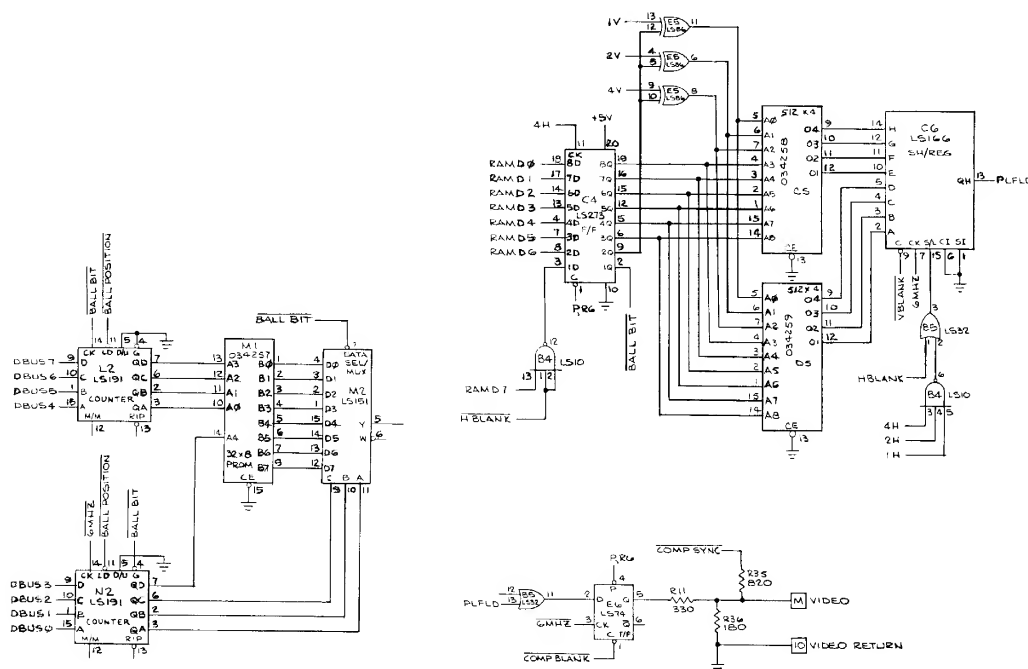


Figure 4-13 Video Interface Schematic Diagram
(Part of Game PCB 030845-XX A)

RAMD5 define the horizontal component of the playfield scan; vertical sync components 1V, 2V, 4V, and RAM D6 define which of eight lines it is scanning.

The playfield picture ROM data is loaded into shift register C6, when 1H, 2H and 4H are all high, and shifted out at a 6MHz rate.

Ball Circuit

When the MPU wants to display a ball picture, it first loads the vertical position of the ball into counter L2 and the horizontal position into counter N2. (Please be aware that the horizontal and vertical references are to the monitor in its normal orientation, not on its end as in the game.) MPU data bits DBUS0 thru DBUS7 are loaded into the counters when BALL POSITION goes low. These data bits define the placement of the ball within a 2 stamp by 2 stamp "window".

The location of the 2 stamp by 2 stamp ball window is determined by the DMA access previously described. When RAMD7 goes high (indicating that the 2x2 stamp window is now being scanned), the low BALL BIT enables horizontal counter N2 and data selector/multiplexer M2.

This technique results in an 8x8 ball picture which can be placed anywhere within a 16x16 ball window. It allows the movement of the ball on the screen to appear smooth, rather than jumping from one stamp to another.

The data output of PROM M1 is a ball, equal in size to one stamp, that is contained in a 2 stamp by 2 stamp window. The PROM receives sixteen addresses from counter L2 that defines which line of the window is to be scanned. Address A4, from horizontal counter N2, tells the PROM to output the left half of the window when low and the right half when high. The lower three bits of horizontal counter N2 select the outputs of the PROM.

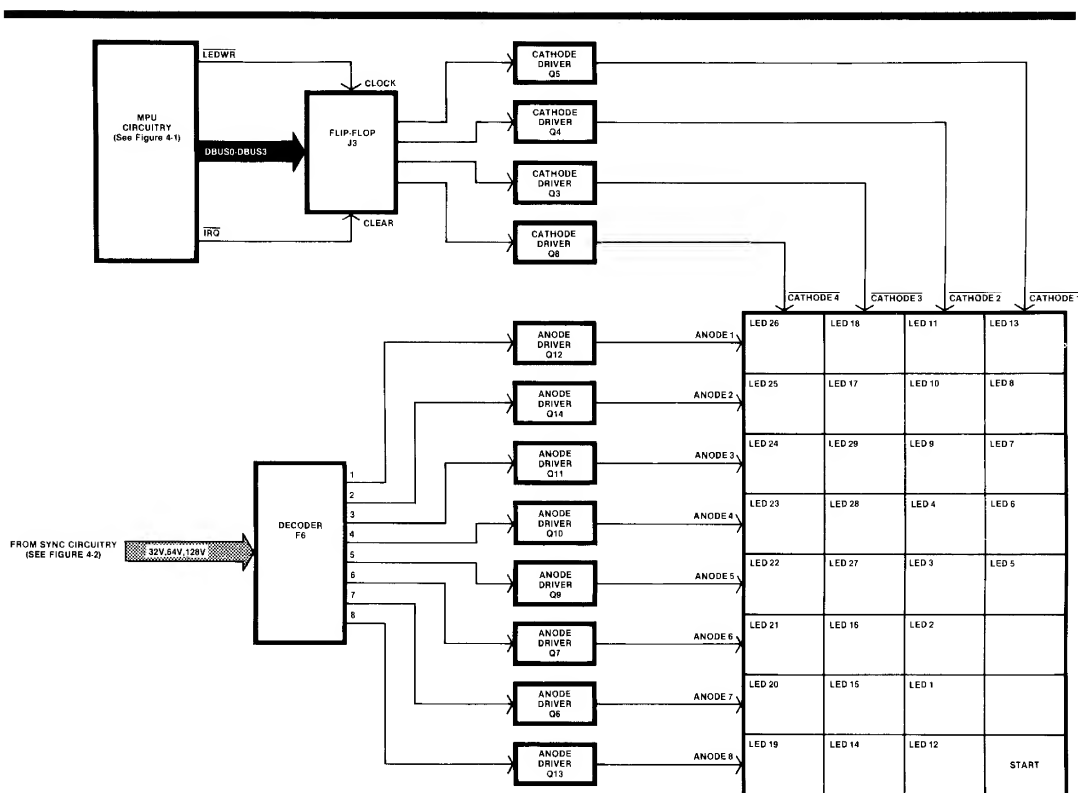


Figure 4-14 LED Circuitry
(Part of Game PCB 030845-XX A)

f. led circuitry

(See Figures 4-14, 4-15 and 4-16)

Two circuits are involved in lighting the LEDs on the Display PCB. These are the anode driver circuit and the cathode driver circuit.

The anode driver circuit is controlled by vertical sync pulses 32V, 64V and 128V. Each anode driver is turned on, one at a time, at a rate of 32V (or every 2 milliseconds). The output of decoder F6 turns on transistors Q6, Q7, and Q9 thru Q14 one at a time.

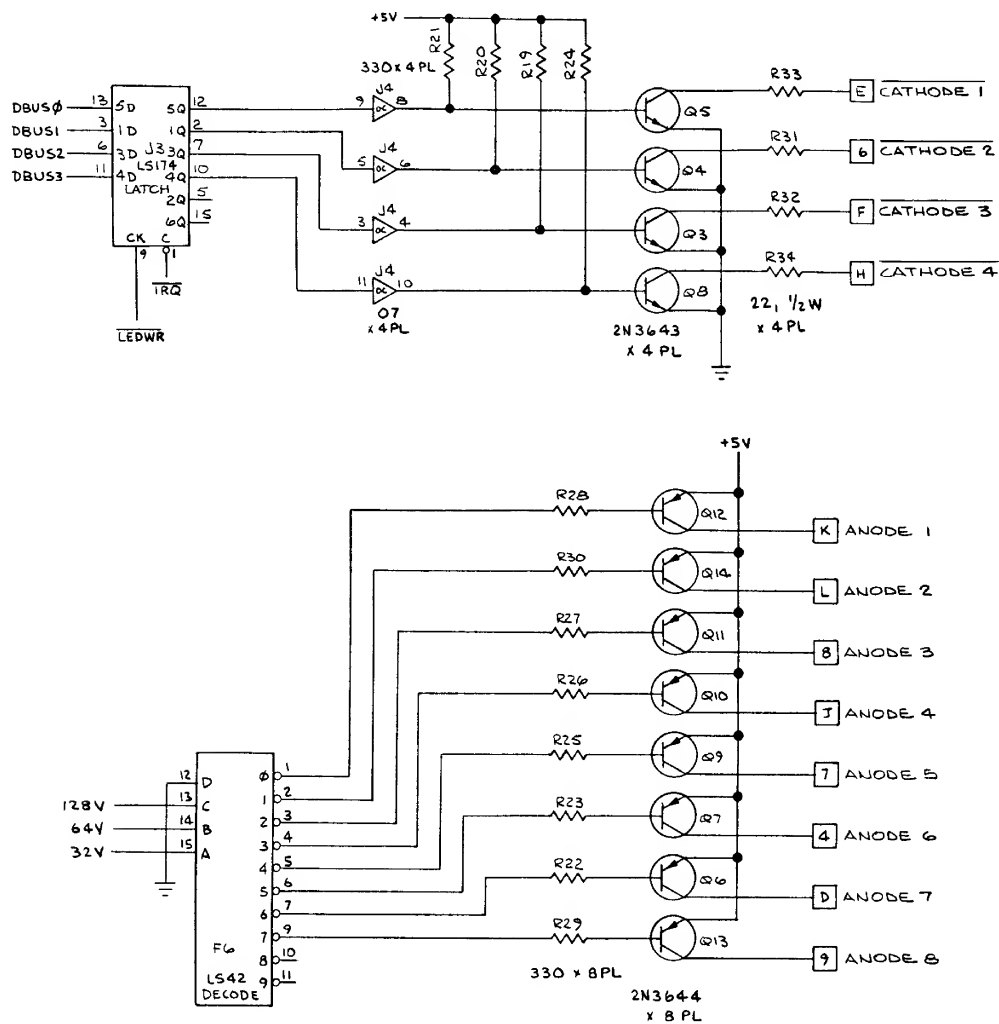


Figure 4-15 LED Driver Schematic
(Part of Game PCB 030845-XX A)

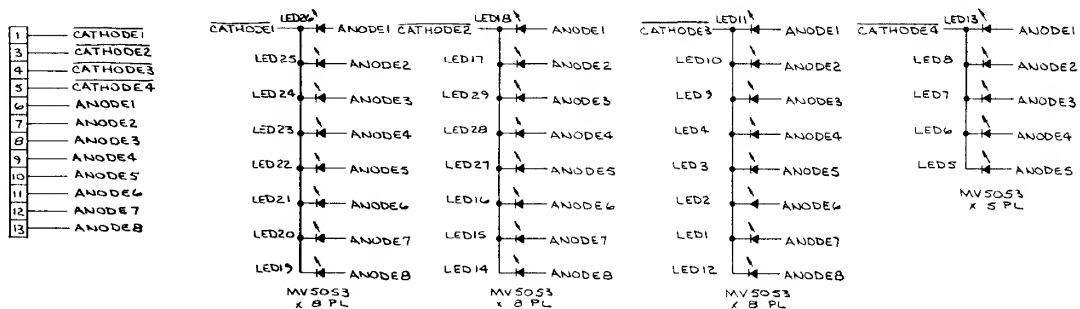
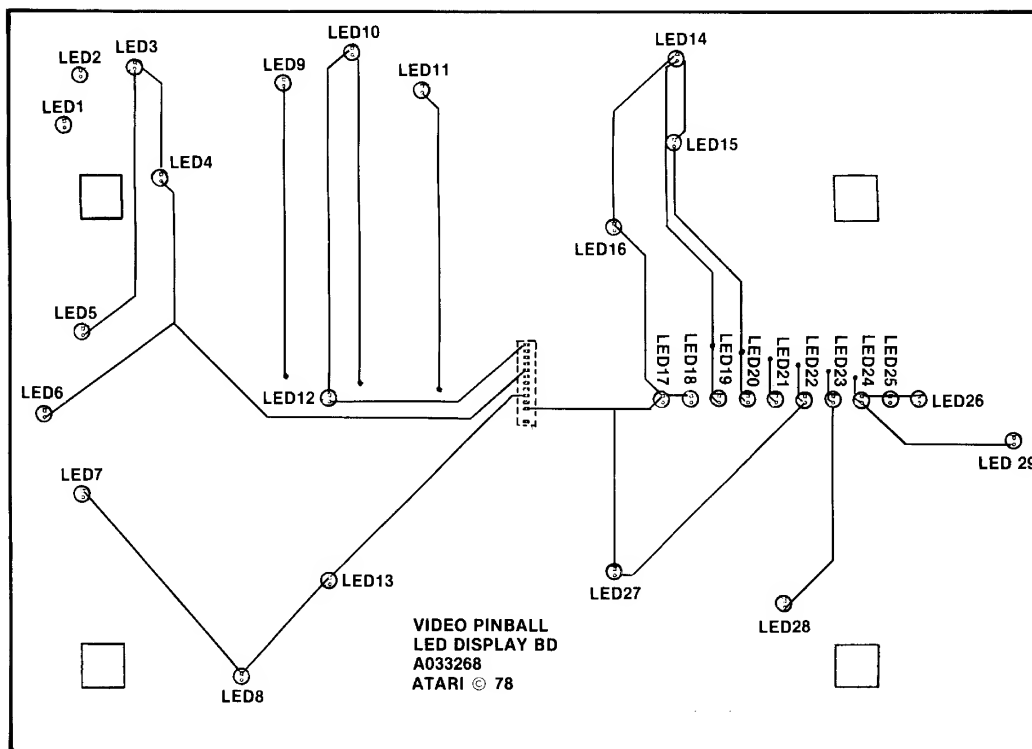


Figure 4-16 LED Display PCB Schematic Diagram A033268-01 A

The cathode driver circuit is controlled by the MPU. On every falling edge of 16V (eight times a frame), IRQ flip-flop D4 (see Figure 4-6) clocks for a low $\overline{\text{IRQ}}$ output. This output does two things, it clears the output of cathode driver latch J3, and it forces the MPU into its IRQ (interrupt request) routine.

During its IRQ routine, the MPU loads data, bits DBUS0 thru DBUS3, into latch J3. LEDWR latches the MPU data bits at the output of latch J3 and sets IRQ flip-flop D4, clearing the $\overline{\text{IRQ}}$. If any of the latched logic bits are high, the corresponding output of buffer J4 is pulled high by one of the pull-up resistors R19 thru R21, and R24, thus turning on the corresponding transistor.

The collector of each anode driver transistor is connected to the anodes of up to four LEDs on the LED Display PCB. Anode 8, the exception, is connected to three LEDs on the LED Display PCB and the START pushbutton LED. The collector of each cathode driver transistor is connected to the cathodes of up to eight LEDs (CATHODE 4 is connected to the cathodes of up to eight LEDs (CATHODE 4 is connected to only five cathodes on the LED Display PCB and the START pushbutton LED). The result is a matrix of LEDs which the MPU can individually light by selecting any LED's cathode while its anode driver is turned on.

g. audio circuitry

(See Figure 4-17 and 4-18)

There are three audio generators in the audio circuitry: 1) the game sound generator, consisting of data selector/multiplexer N4, flip-flops M4 and N5, programmable counters K4 and L4, latch L3 and associated gates; 2) the bell generator, consisting of counter H6 and transistors Q15, Q17 and Q18; and 3) the bong generator, consisting of AND gate M6. All three audio generators are summed at the input of amplifier E8. Each summed audio input is decoupled through capacitors C44 thru C48. During the attract mode, audio amplifier E8 is disabled by the ATTRACT signal through transistor Q16.

The MPU sets up the game audio generator by latching the counter frequency data into L3, which in turn controls programmable counters K4 and L4.

Next the MPU outputs an address that results in an OUT1 output from address decoder L1. This signal allows the MPU to latch data bits DBUS0 thru DBUS2 at the output of latch N3 (see Figures 4-6 and 4-7). Signals OCTAVE0 thru OCTAVE2 select one of the various fre-

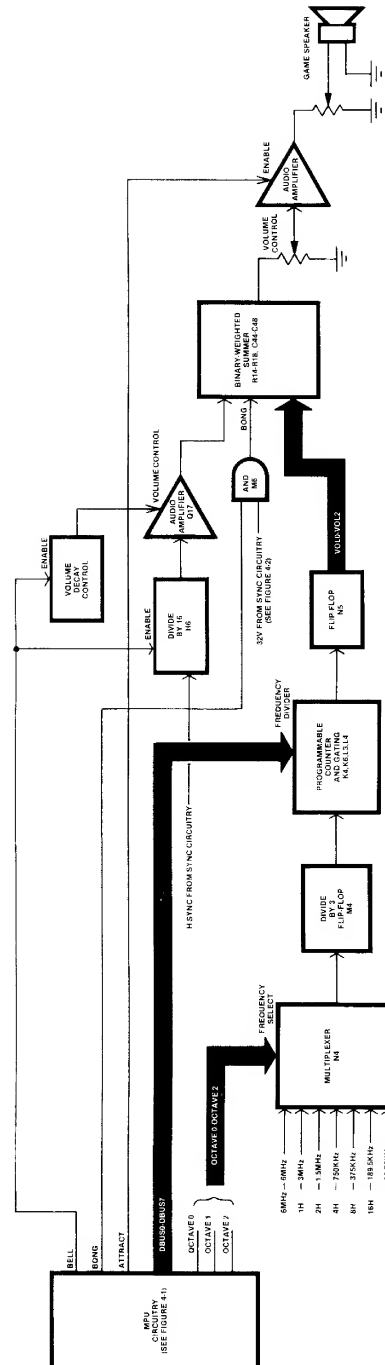


Figure 4-17 Audio Circuitry
(Part of Game PCB 030845-XX A)

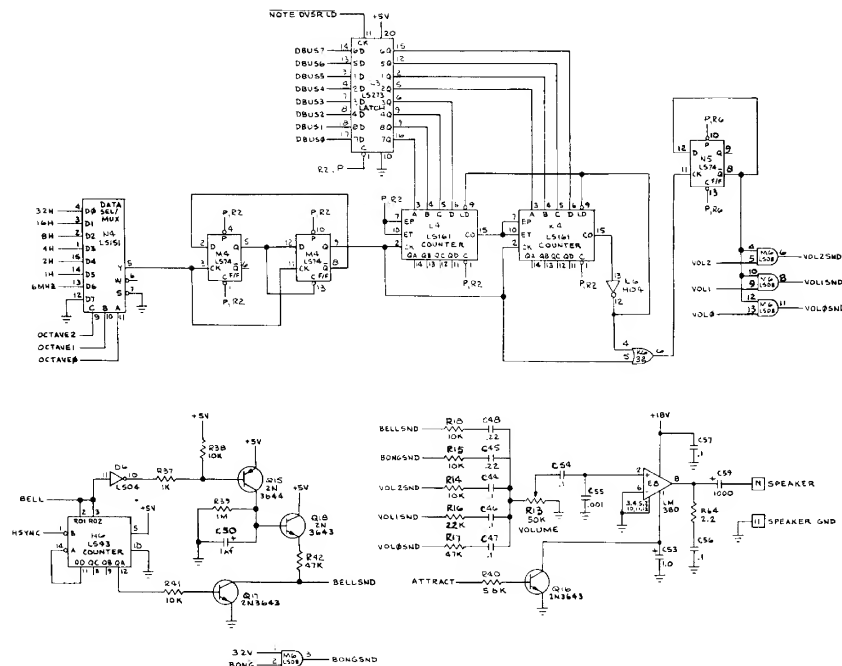


Figure 4-18 Audio Schematic Diagram
(Part of Game PCB 030845-XX A)

quency inputs to data selector/multiplexer N4. Flip-flop M4 divides the selected frequency by a factor of three.

This frequency is then used to clock counters K4 and L4. This technique of varying the clock frequency to counters K4 and L4 allows the MPU to determine the "octave" in which the previously selected "note" is played.

There is no output from the game sound generator unless the MPU outputs an address that results in an **OUT2** signal from address decoder M3. This allows the MPU to select a volume output through data bits DBUS0 thru DBUS2 (see Figures 4-6 and 4-7). Data bits VOL0 thru VOL2 are applied to the inputs of AND gate M6. The outputs of the AND gate are summed at the volume control through binary-weighted summing resistors R14, R16 and R17 (voltage output through R14 is one half of output through R16. Voltage output through R16 is one half of output through R17).

The bell generator is enabled when the MPU outputs the address and data that results in a high BELL signal from latch M3. When BELL goes high, transistor Q15

conducts, resulting in the charging of capacitor C50. When C50 charges, transistor Q18 is biased on. When the BELL signal goes low, counter H6 begins to count and divides the HSYNC frequency by a factor of sixteen. With every positive pulse at the QA output of counter H6, transistor Q17 conducts. With the BELL signal low, capacitor C50 begins to discharge through resistor R39 (time constant of R39/C50 combination - 1 TC equals 1 second). The resulting output of transistor Q17 is approximately 980 Hz within a diminishing amplitude envelope.

The bong generator is turned on when the MPU outputs the address and data that results in a high BONG signal from latch M3. When BONG goes high, the approximately 250 Hz output of AND gate M6 is applied to the audio amplifier through resistor R15.

Audio amplifier E8 amplifies the audio generated by the previously mentioned circuit. The amplification (or volume) is controlled by the on-board volume control potentiometer, R13. The PCB audio output is also applied across a second volume control, conveniently located inside the coin door.

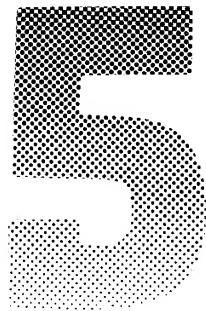


illustrated parts catalog

The purpose of this chapter is to provide you with the necessary information for ordering replacement parts for the Video Pinball™ game.

When ordering parts from your distributor, give the part number, part name, applicable figure number of this catalog, and serial number of your game. This will help to avoid confusion and mistakes in your order. We hope the results will be less downtime and more profit from your game.

Video Pinball™



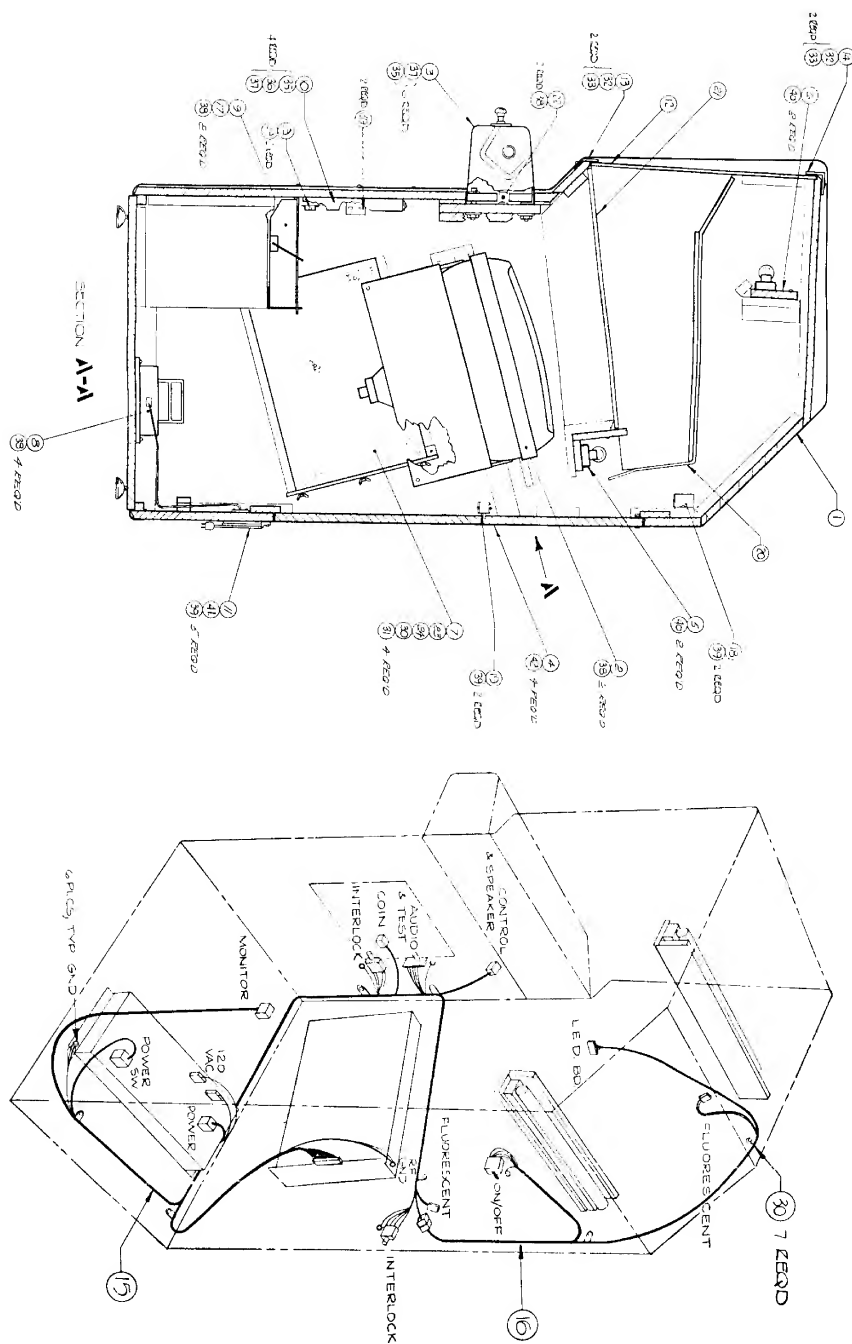


Figure 5-1 Final Assembly
A033790-01 C

**Figure 5-1 Final Assembly
Parts List**

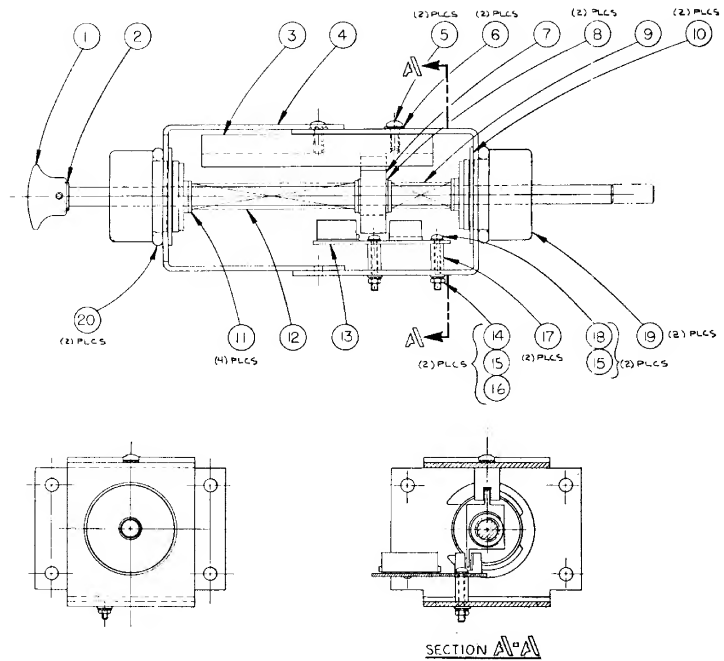
Item	Part Number	Qty.	Description
1	A033792-01	1	Cabinet Assembly
2	A033823-01	1	Monitor Support Weldment Assembly—see Figure 5-5
3	A034178-01	1	Control Panel Assembly—see Figure 5-2
4	A033813-01	1	Rear Door Assembly
5	A033809-01	1	Fluorescent Light Board Assembly, Lower (blacklight)
6	A033811-01	1	Fluorescent Light Board Assembly, Upper
7	A030867-01	1	R.F. Shield Enclosure Assembly
8	A007197-01	1	Type "B" Power Supply Assembly—see Figure 5-4
9	A007902-01	1	Cash Box Assembly
10	A009083-01	1	
	thru -07	1	Coin Door Assembly—see Figure 5-8
11	A033016-01	1	Power Cord Assembly
12	033622-01	1	Shield, Monitor W/Graphics
13	033780-01	1	Retainer, Monitor Shield, Lower
14	033781-01	1	Retainer, Monitor Shield, Upper
15	A034028-02	1	Harness (Main) & Component Assembly
16	A034029-02	1	Harness (Top) & Component Assembly
17	006870-01	1	Coin Box Bracket
18	009992-01	1	Switch Cover, On-Off
19	007882-02	2	Switch Cover, Interlock
20	A034173-01	1	Playfield Assembly—see Figure 5-6
21	033796-01	1	Mirror
22	033797-01	1	Bracket, Switch, Activator
23	030868-01	4	Connector Mount with pin
24	46-2013002	2	Fuse, 3-Amp, slow-blow (power supply fuses F1 and F2)
27	78-67032	A/R	Tape, Black Paper (2" wide)
28	A030845-01	1	Game Board PROM
29	A034036-01	1	R.F. P.C.B. (End Board)—see Figure 5-12
31	72-1406S	4	Screw, Mach. Pan-Head Phil. #4-40 × 3/8"
32	82-8016	4	Screw, Button-Head, Socket Cap #10-32 × 1.00 (Blk)
33	75-040	4	Washer, #10 Split Lock
35	75-015S	10	Washer, Flat 1/4"
36	75-5516B	4	Bolt, Carriage 1/4"-20 × 1.00"
37	75-990505S	10	Nut, Lock, Shallow Pattern 1/4"-20
38	72-6812	11	Screw, Self-Tapping, Pan-Head Phil. #8 × 3/4"
39	72-6610	28	Screw, Self-Tapping, Pan-Head Phil. #6 × 5/8"
40	72-6620	4	Screw, Self-Tapping, Pan-Head Phil. #6 × 1 1/4"
41	78-25002	1	Tie Wrap, Screw-Down
42	82-1824	4	Screw, Wood, Flat-Head, #8 × 1 1/2"



**Figure 5-2 Control Panel Assembly
Parts List**

Item	Part Number	Qty.	Description
1	A034176-01	1	Control Panel Sub-Assembly
2	033779-01	1	Cap, End, Control Panel (Left)
3	033779-02	1	Cap, End, Control Panel (Right)
4	033621-01	1	Panel W/Graphics, Console, Top
5	A033590-01	1	Ball Shooter Assembly, Optical—See Figure 5-3
6	A033591-01	1	Plate Assembly, Front
7	A020895-01	2	Flipper Button Assembly
8	020893-01	3	Switch
9	48-004	1	Speaker, 5"
10	000869-01	1	Speaker Grill
11	001856-01	1	Bushing, Aluminum
12	62-002	1	LED Switch, Lighted
13	033802-01	1	Hinge, Console
14	021105-01	3	Header Plate, Leaf Switch
15	72-6812	13	Screw, Self-Tapping, Pan-Head Phil., #8 × 3/4"
16	72-6424S	6	Screw, Self-Tapping, Pan-Head Phil., #4 × 1 1/2"
17	75-044S	6	Washer, Split Lock, #4
18	75-910S	5	Nut, Hex, #10-32
19	75-040S	5	Washer, Split-Lock, #10
20	73-77015	4	Rivet, 3/16" × .68, black
21	72-6610S	7	Screw, Self-Tapping Pan-Head Phil., #6 × 5/8"
22	82-8016	2	Screw, Button-Head, Socket-Head, #10-32 × 1.00"
23	75-5518B	4	Bolt, Carriage, Black Oxide 1/4-20 × 1 1/4"
24	75-019S	10	Washer, Flat, 5/16"
25	75-914S	4	Nut, Hex, 1/4-20
26	35-G1528S	3	Screw, Shoulder, Hex Hd, Socket, 5/16" × .175"
27	78-3002040	3	Spring
28	75-050	2	Washer, Lock, Internal Tooth, #10
29	75-045	4	Washer, Split, Lock, 1/4"
30	75-015S	3	Washer, Flat, 1/4"
31	A034031-01	1	Ground Strap
32	78-6900802	A/R	Tape, Foam, Adhesive (17" Lg.)
33	78-6900402	A/R	Tape, Foam, Adhesive (15" Lg.)
34	A034030-01	1	Control Harness Assy.
35	75-07054	1	Washer, Flat, Nylon ID = .470"/OD = .968" × .075" thick
36	75-9910N0	2	Palnut, 5/8"-11
37	75-990505S	3	Nut, Hex, Self-Locking, Steel 1/4-20





Detail of Item 13, Steering Board Assy.:

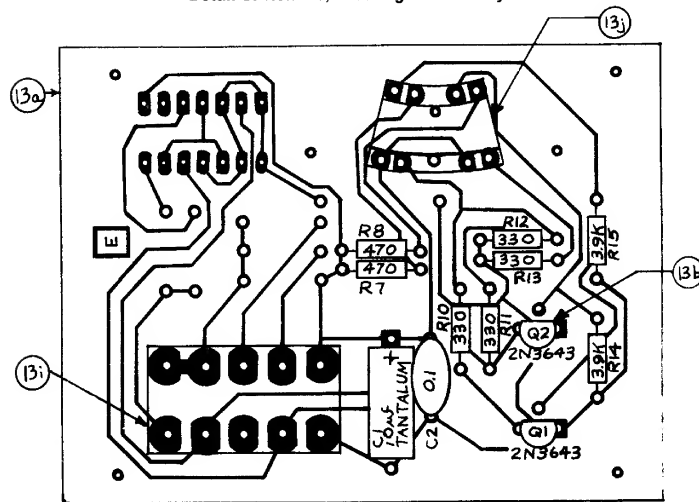


Figure 5-3 Optical Ball Shooter Assembly
A033590-01 C

**Figure 5-3 Optical Ball Shooter Assembly
Parts List**

Item	Part Number	Qty.	Description
1	A033592-01	1	Plunger Assy
2	89-14110001	1	"O" Ring
3	033593-01	1	Guide
4	A033594-01	1	Bracket, Weldment
5	72-1808S	2	Screw, Machine, Pan-Head Cross-recessed #8-32 UNC-2A x 1/2" cadmium-plated steel
6	75-058	2	Washer, Lock, Internal Tooth, #8
7	033595-01	1	Flag
8	73-3006	2	"E" Ring for 3/8" Dia. Shaft
9	033596-01	1	Spring, Return
10	73-3026	2	"E" Ring for 1 3/8" Dia. Shaft
11	75-07020	4	Washer, Special Flat
12	033597-01	1	Spring, Thrust
13	A009060-03	1	Board, Assy., Steering, consisting of the following:
13a	009061-01	1	P.C. Board
13b	78-13024	A/R	Epoxy, Devcon "5 Minute"
13c	10-5392	2	Resistor, Carbon Composition, 1/4W, 5%, 3.9K Ohm R14,15
13d	10-5331	4	Resistor, Carbon Composition, 1/4W, 5%, 330 Ohm R10-13
13e	10-5471	2	Resistor, Carbon Composition, 1/4W, 5%, 470 Ohm R7,8
13f	27-250104	1	Capacitor, Ceramic Disc, .1uf, 25V C2
13g	29-046	1	Capacitor, Tant., 10uf, 20V C1
13h	34-2N3643	2	Transistor, 2N3643 Q1,2
13i	79-58005	1	Connector, 10-Position
13j	030369-01	1	Optical Coupler
14	75-914S	2	Nut, Machine, Hex, #4-40 UNC-2B Steel Cadmium-plated
15	75-054	4	Washer, Lock, Internal Tooth, #4
16	75-034S	2	Washer, Flat, #4
17	74-2408P	2	Spacer
18	72-1416S	2	Screw, Machine, Pan-Head, Cross-recessed, #4-40 UNC-2A x 1" steel cadmium-plated
19	A033598-01	2	Bearing Assy.
20	006127-06	2	Bumper



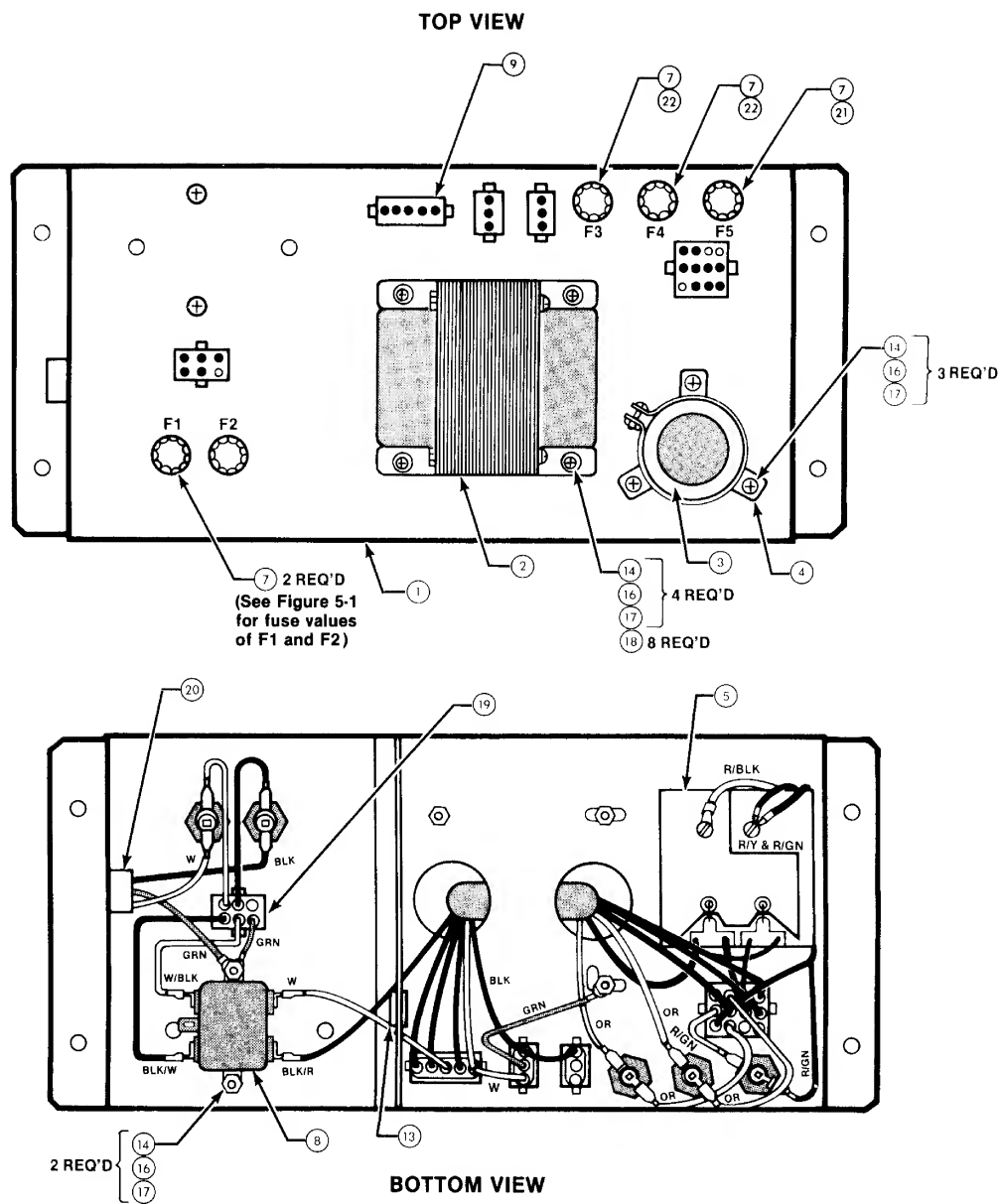


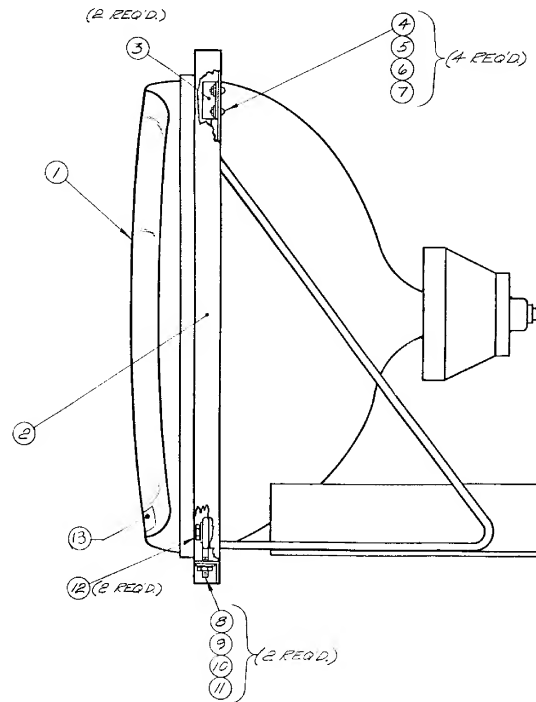
Figure 5-4 Type B Power Supply Assembly
A007197-01 J

**Figure 5-4 Type B Power Supply Assembly
Parts List**

Item	Part Number	Qty.	Description
1	A009266-01	1	Power Supply Base Weldment Assembly
2	A006886-01	1	Transformer Termination Assembly, "Type B"
3	29-053	1	Capacitor, Sprague Electrolytic 26,000 μ f @ 15V
4	78-70501SC	1	Bracket, Capacitor Mounting, Sprague #4586-48
5	A006555-01	1	P.C. Board Rectifier
7	79-4411004	5	Fuse Holder, Panel Mounting
8	41-2003	1	Filter, Power Line, 5 AMP
9	A006958-01	A/R	Voltage Selection Block, 95V (black)
10	A006958-02	A/R	Voltage Selection Block, 110V (orange)
11	A006958-03	A/R	Voltage Selection Block, 205V (green)
12	A006958-04	A/R	Voltage Selection Block, 220V (red)
13	78-2708	1	Grommet, Plastic
14	72-1810S	9	Screw, Pan-Head, #8-32 \times 5/8"
16	75-048	9	Washer, Split Lock, #8
17	75-918S	9	Nut, Hex, #8
18	75-018S	8	Washer, Flat, #8
19	A007192-01	1	Power Switch Termination
20	A007444-01	1	Power In Harness
21	46-203801	1	Fuse, 8-amp, 125V, 3 AG Fast-Acting
22	46-201251	2	Fuse, 2 1/2-amp, 125V, Slow-Acting



**Figure 5-5 Monitor Support Weldment Assembly
A033823-01 C**

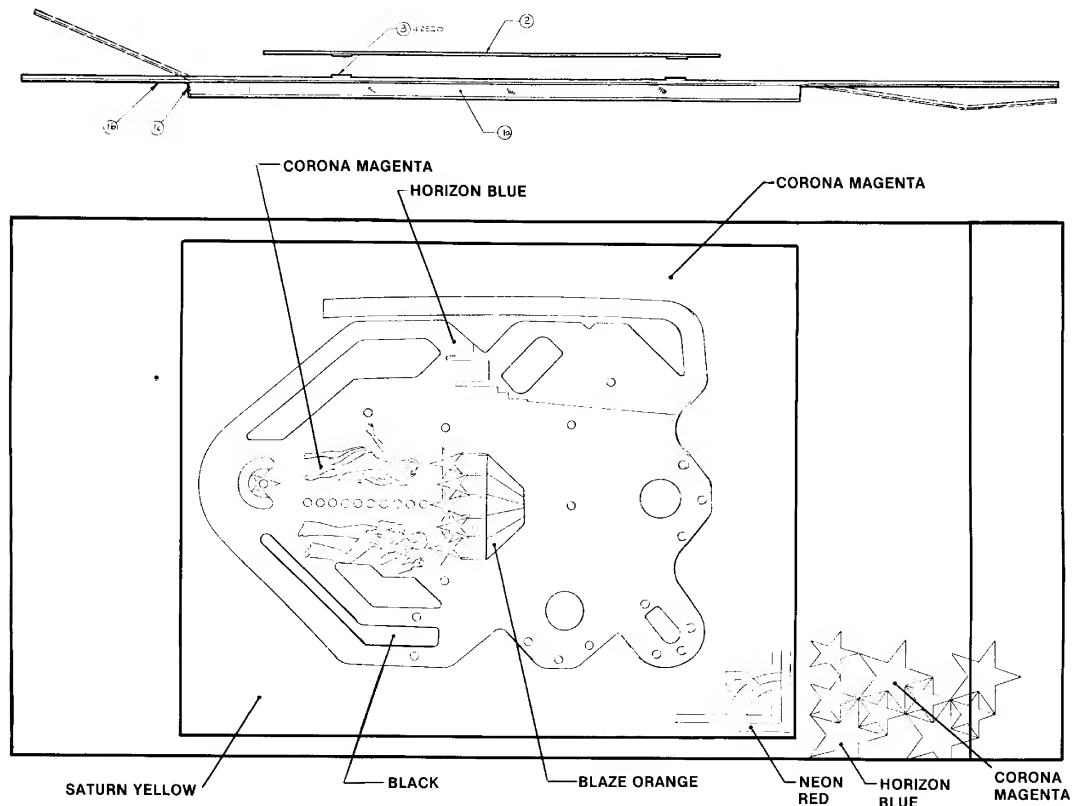


Parts List

Item	Part Number	Qty.	Description
1	92-040	1	Monitor, Wells-Gardner 23" Model 22V1001
2	033782-01	1	Weldment, Monitor Support
3	033827-01	2	Bracket, Monitor Mount
4	75-5112	4	Bolt, Carriage, #10-24 x 3/4"
5	75-010S	4	Washer, Flat, #10
6	75-040	4	Washer, Split-Lock, #10
7	75-911S	4	Nut, Hex-Head, #10-24
8	82-406	2	Eye Bolt, #1/4-20 x 2.00"
9	75-015S	2	Washer, Flat, #1/4
10	75-045	2	Washer, Split-Lock, #1/4
11	75-915S	2	Nut, Hex-Head, #1/4-20
12	72-6812S	2	Screw, Self-Tapping, Type AB Pan-Hd. Phil. Steel #8 x 3/4"
13	006319-03	1	Copyright Decal, 1978



Figure 5-6 Playfield Assembly
A034173-01 B

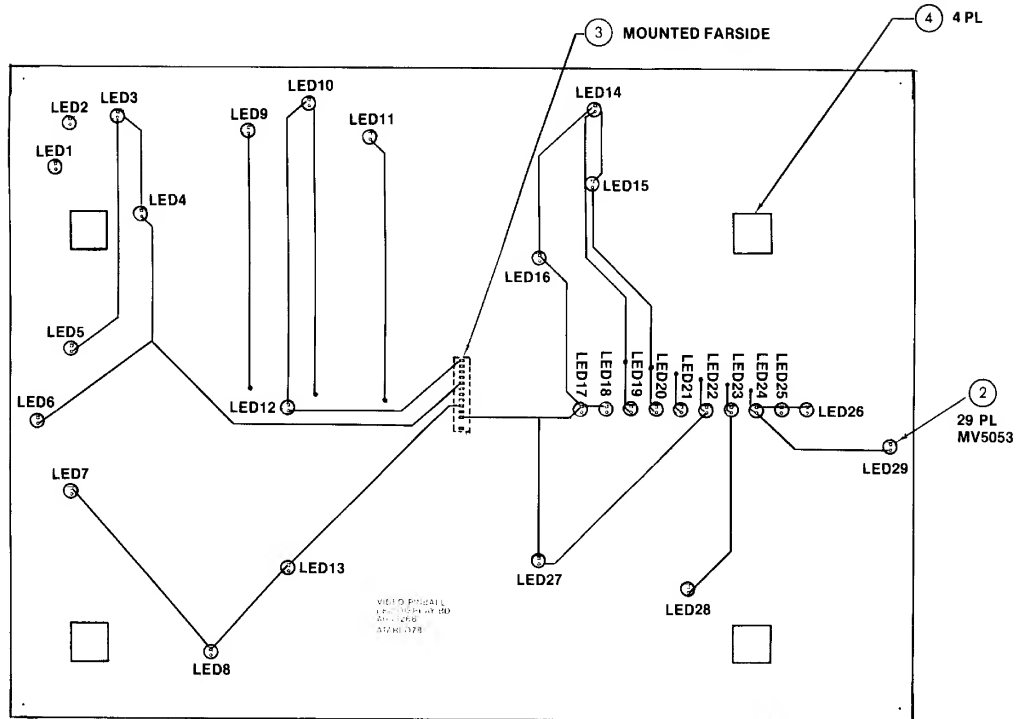


Parts List

Item	Part Number	Qty.	Description
1	A034174-01	1	Playfield Sub-Assy., consisting of the following items:
1a	034172-01	1	Playfield Island Fabrication with Graphics
1b	034171-01	1	Playfield Base Fabrication with Graphics
1c	78-67006	A/R	Tape, Paper, Black (3/8" Wide)
2	A033268-01	1	LED Display Board
3	034310-01	4	Hook Fastener with Pressure-Sensitive Adhesive (5/8" × 5/8")



Figure 5-7 LED Display Board Assembly
A033268-01 A



Parts List

Item	Part Number	Qty.	Description
1	033269-01	1	P.C. Board
2	38-MV5053	29	LED, Opto-electric Red LED1-LED29
3	79-58159	1	Header, 12-Position
4	034311-01	4	Loop Fastener, with pressure-sensitive adhesive, 5/8" x 5/8"

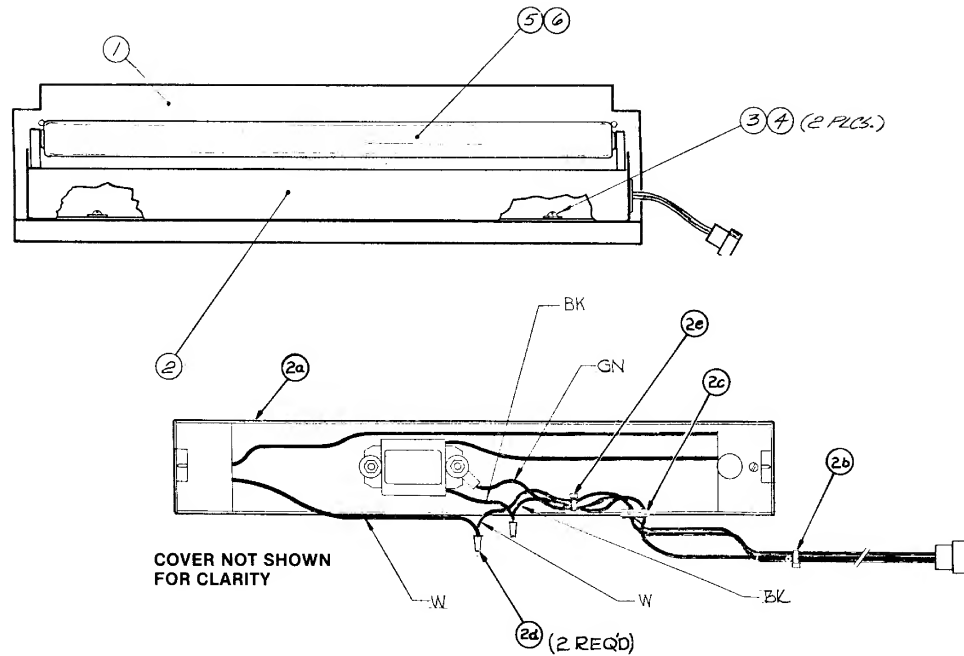


**Figure 5-8 Coin Door Assembly
Parts List**

Item	Part Number	Qty.	Description
1	A007637-01	1	Front Bezel Assy.—Used only on -01 Coin Door Assy. (25¢)
	A007637-02	Ref.	Front Bezel Assy.—Used only on -02 Coin Door Assy. (5 Fr)
	A007637-03	Ref.	Front Bezel Assy.—Used only on -03 Coin Door Assy. (1 DM)
	A007637-04	Ref.	Front Bezel Assy.—Used only on -04 Coin Door Assy. (1 Kr)
	A007637-05	Ref.	Front Bezel Assy.—Used only on -05 Coin Door Assy. (100 Y)
	A007637-06	Ref.	Front Bezel Assy.—Used only on -06 Coin Door Assy. (10 pence)
	A007637-07	Ref.	Front Bezel Assy.—Used only on -07 Coin Door Assy. (20¢ Australian)
2	75-9165	4	Nut, #6-32
3	A030362-01	1	Coin Lock-Out Assembly
4	A007640-01	2	Coin Switch Assembly
5	A002465-01	1	Coin Counter Assembly
6	004320-01	1	Coin Door Weldment
7	004341-01	2	Secondary Coin Chute
8	004344-01	1	Key Loop
9	004340-01	2	Spring Return
10	004337-01	2	Bracket, Wire Form
11	004338-01	1	Lock-Out Wire Form, R.H.
12	004336-01	1	Lock-Out Wire Form, L.H.
13	004326-01	2	Button, Scavenger
14	75-046	4	Lock Washer, #6
15	006904-01	2	Spacer
16	007359-01	1	Lamp Socket
17	70-11-47	1	Lamp
18	73-3008	2	Retaining "C" Ring, Truarc #5103-25
19	75-9914001	6	Self-Threading Nut, Tinnerman #SR188006
20	75-026S	4	Washer, #6
21	75-00516	13	Kepnut, Style 842, Steel, #6-32
22	008629-01	2	Spring
23	71-2118	1	Lock Assembly
24	71-1225CU	2	Coin Mechanism for American Quarter Only
	71-125FB	Ref.	Coin Mechanism for Belgian 5 Francs Only
	71-1205MG	Ref.	Coin Mechanism for German Mark Only
	71-1201KS	Ref.	Coin Mechanism for Swedish Krona Only
	71-1201YJ	Ref.	Coin Mechanism for Japanese 100 Yen Only
	71-1210PE	Ref.	Coin Mechanism for English 10 Pence Only
	71-1220CA	Ref.	Coin Mechanism for Australian 20-Cent Piece Only
25	007753-01	1	Plate, Anti-Probe
26	A007638-01	1	Switch Assembly, Slam
27	A006921-01	1	Harness Assembly



Figure 5-9 Lower Fluorescent Light Board Assembly
A033809-01 A

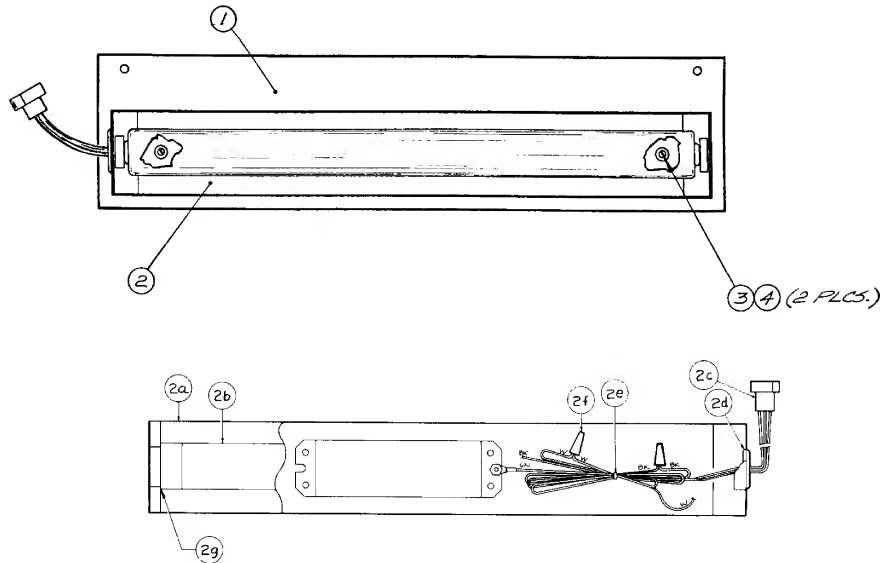


Parts List

Item	Part Number	Qty.	Description
1	033808-01	1	Light Board, Lower
2	A008860-01	1	Assy., 18" Fluorescent (Black Light)—consisting of the following:
2a	93-109	1	Simkar Fluorescent Fixture 18"
2b	A005493-01	1	Fluorescent Light Harness 18"
2c	78-2652	1	Grommet, Rubber
2d	79-561816	2	Wire Nut, Ideal 71-8
2e	78-24001	A/R	Tie Wrap
3	72-6810	2	Screw, S.M.P. Hd. Phil. #8 × 5/8"
4	75-010S	2	Washer, Flat, #10
5	70-308	1	Tube, 18" Fluorescent (BLB)
6	99-11006	2	Lamp Socket Clip



Figure 5-10 Upper Fluorescent Light Board Assembly
A033811-01 A



Parts List

Item	Part Number	Qty.	Description
1	033810-01	1	Light Board, Upper
2	A005495-01	1	Assy., 18" Fluorescent
2	A005495-01	1	Assy., 18" Fluorescent (white) — consisting of the following:
2a	93-104	1	Gibson Fluorescent Fixture 18 inch
2b	70-303	1	Fluorescent Tube 18 inch (or Equivalent)
2c	A005493-01	1	Fluorescent Light Harness
2d	78-2652	1	Grommet, Rubber
2e	78-24001	A/R	Tie Wrap
2f	79-561816	2	Wire Nut, Ideal 71-B
2g	99-11006	2	Lamp Socket Clip
3	72-6810	2	Screw, S.M.P. Hd. Phil. #8 × 5/8"
4	75-010S	2	Washer, Flat, #10



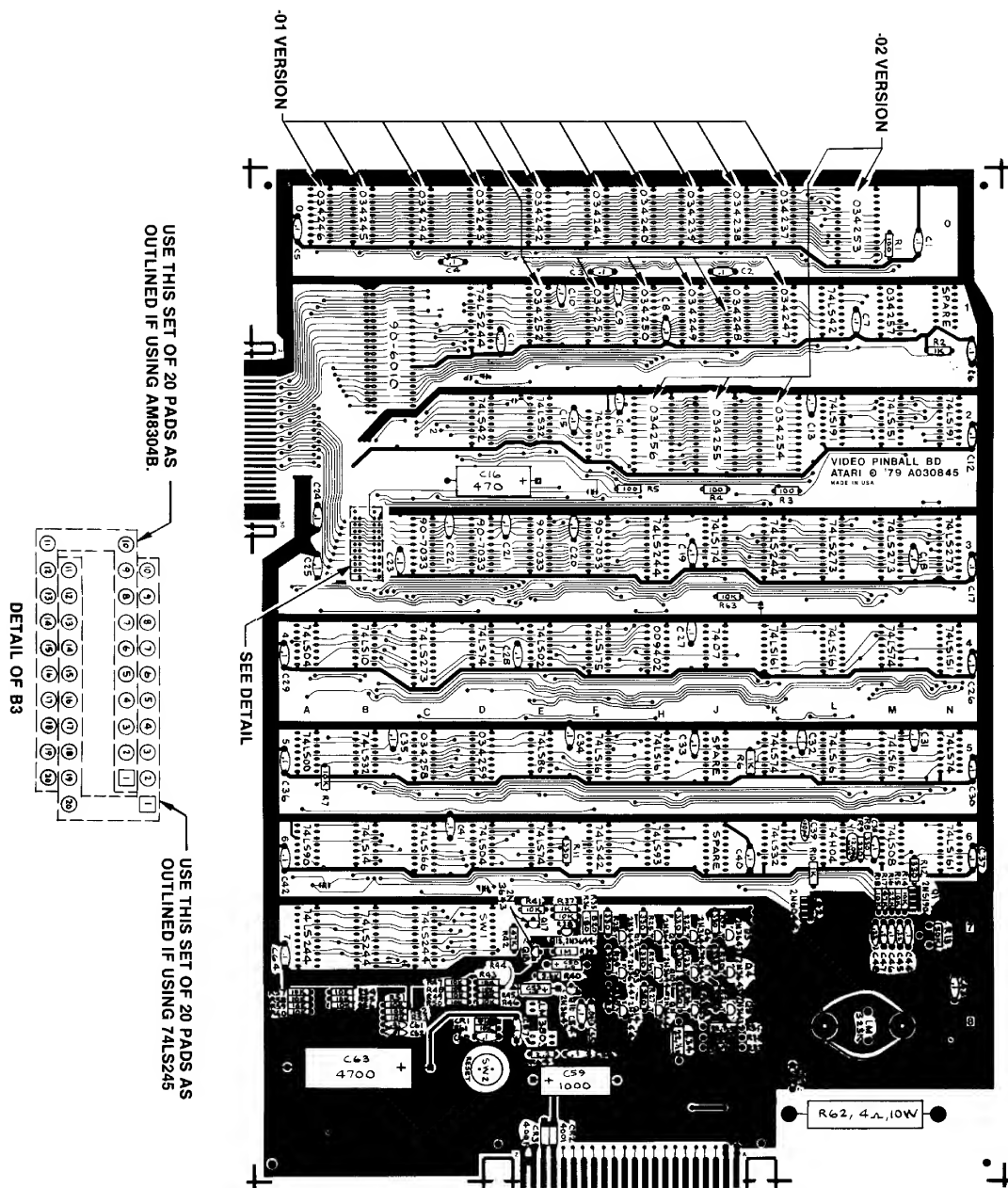


Figure 5-11 Video Pinball PCB Assembly
A030845-01 A

**Figure 5-11 Video Pinball P.C. Board Assembly
Parts List**

Item	Part Number	Qty.	Description
1	030846-01	1	P.C. Board
2	10-5101	4	Res., Carbon Comp., 5%, 1/4W, 100 Ohm R1, 3, 4, 5
3	10-5181	1	Res., Carbon Comp., 5%, 1/4W, 180 Ohm R36
4	10-5331	16	Res., Carbon Comp., 5%, 1/4W, 330 Ohm R8, 9, 11, 12, 19-30
5	10-5821	1	Res., Carbon Comp., 5%, 1/4W, 820 Ohm R35
6	10-5102	4	Res., Carbon Comp., 5%, 1/4W, 1K Ohm R2, 6, 37, 10
7	10-5562	1	Res., Carbon Comp., 5%, 1/4W, 5.6K Ohm R40
8	10-5103	26	Res., Carbon Comp., 5%, 1/4W, 10K Ohm R7, 14, 15, 18, 38, 41, 43-61, 63
9	10-5223	1	Res., Carbon Comp., 5%, 1/4W, 22K Ohm R16
10	10-5473	2	Res., Carbon Comp., 5%, 1/4W, 47K Ohm R17, 42
11	11-5220	4	Res., Carbon Comp., 5%, 1/2W, 22 Ohm R31-34
12	19-315503	1	Trimpot, Vert., 50K Ohm R13
13	19-80W4P0	1	Res., Power, Wirewound, 4 Ohm, 10W R62
14	10-5105	1	Res., Carbon Comp., 5%, 1/4W, 1M Ohm R39
15	10-52P2	1	Res., Carbon Comp., 5%, 1/4W, 2.2 Ohm R64
18	24-250105	2	Cap., Electrolytic, 25V, 1μf C50, 53
19	24-250477	1	Cap., Electrolytic, 25V, 470μf C16
20	24-250108	1	Cap., Electrolytic, 1000μf C59
21	24-250478	1	Cap., Electrolytic, 4700μf C63
22	27-250102	1	Cap., Ceramic Disc, 25V, .001μf C55
23	27-250103	2	Cap., Ceramic Disc, 25V, .01μf C61, 62
24	27-250104	49	Cap., Ceramic Disc, 25V, .1μf C1-15, 17-38, 40-44, 46, 47, 54, 56, 57, 60, 64
25	27-250224	3	Cap., Ceramic Disc, 25V, .22μf C45, 48, 49
26	28-101101	1	Cap., Mica, Dipped, 100V, 100pf C39
32	31-1N914	1	Diode, 1N914 CR1
33	31-1N4001	2	Diode, 1N4001 CR2, 3
38	33-2N3644	9	Transistor, PNP, 2N3644 Q6, 7, 9-15
39	34-2N3643	7	Transistor, NPN, 2N3643 Q3-5, 8, 16-18
40	34-2N5190	1	Transistor, NPN, 2N5190 Q1
41	34-2N6044	1	Transistor, NPN, 2N6044 Q2
46	37-74LS00	1	Integrated Circuit, 74LS00 A5
47	37-74LS02	1	Integrated Circuit, 74LS02 E4
48	37-74H04	1	Integrated Circuit, 74H04 L6
49	37-74LS04	2	Integrated Circuit, 74LS04 A4, D6
50	37-7407	1	Integrated Circuit, 7407 J4
51	37-74LS08	1	Integrated Circuit, 74LS08 M6
52	37-74LS10	1	Integrated Circuit, 74LS10 B4
53	37-74LS14	1	Integrated Circuit, 74LS14 B6
54	37-74LS32	3	Integrated Circuit, 74LS32 E2, B5, K6



Figure 5-11 Video Pinball PCB Assembly, continued
Parts List

Item	Part Number	Qty.	Description
55	37-74LS42	3	Integrated Circuit, 74LS42 L1, D2, F6
56	37-74LS74	5	Integrated Circuit, 74LS74 D4, M4, K5, N5, E6
57	33-74LS86	1	Integrated Circuit, 74LS86 E5
58	37-74LS90	1	Integrated Circuit, 74LS90 A6
59	37-74LS93	1	Integrated Circuit, 74LS93 H6
60	37-74LS151	2	Integrated Circuit, 74LS151 M2, N4
61	37-74LS161	7	Integrated Circuit, 74LS161 K4, L4, F5, H5, L5, M5, N6
62	37-74LS166	1	Integrated Circuit, 74LS166 C6
63	37-74LS174	1	Integrated Circuit, 74LS174 J3
64	37-74LS175	1	Integrated Circuit, 74LS175 F4
65	37-74LS191	2	Integrated Circuit, 74LS191 L2, N2
66	37-74LS244	6	Integrated Circuit, 74LS244 D1, H3, K3, A7, B7, C7
67	37-74LS245	1	Integrated Circuit, 74LS245 B3
68	37-LM380N	1	Audio Amplifier, LM380 E8
69	37-LM323K	1	Regulator, +5V, LM323K
70	37-74LS157	1	Integrated Circuit, 74LS157 F2
71	37-74LS273	4	Integrated Circuit, 74LS273 L3, M3, N3, C4
74	62-001	1	Switch, SPST, Momentary (SW2)
75	66-118P1T	1	Switch, SPST × 8, DIP (SW1) D7
80	72-1608C	2	Screws, Pan-Head, Phil., #6-32 × 1/2" CRES
81	75-016C	2	Washer, Flat, #6, CRES
82	75-056C	2	Washer, Lock, Int. Star, #6, CRES
83	75-916C	2	Nut, Hex, #6-32, CRES
84	78-06001	1	Heatsink (LM323K)
87	78-16005	1	Silpad (LM323K)
88	79-42C40	1	Socket, 40-Pin, Medium Insertion Force C1
92	90-102	1	Crystal, 12.096 MHz Y1
96	90-6010	1	Microprocessor, 6502 C1
97	90-7033	4	RAM, 2114 C3, D3, E3, F3
101	009402-01	1	Sync PROM (82S129) H4
102	034257-01	1	Video PROM (82S123) M1
103	034258-01	1	Playfield 1 (82S131) C5
104	034259-01	1	Playfield 2 (82S131) D5
<i>For remaining memory components and their part numbers, see next page.</i>			

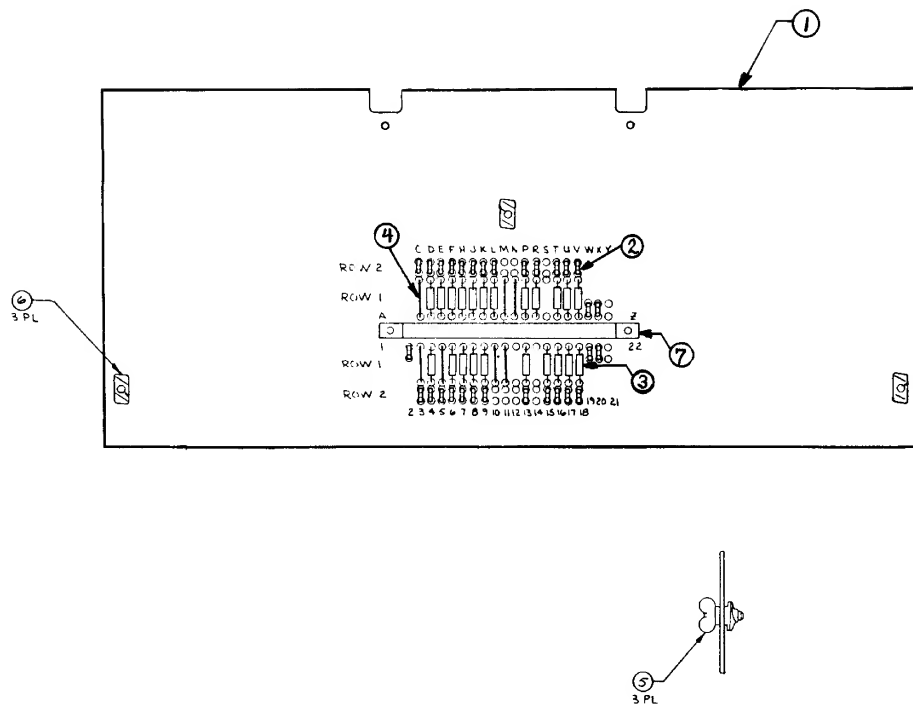


**Figure 5-11 Video Pinball PCB Assembly, continued
Parts List**

**Memory Equivalency Table
and Part Numbers**

If circuitry is faulty, self-test will display the following message during ROM test:	-01 P.C. Board using 1K × 4 PROMs	-01 P.C. Board using 2K × 4 PROMs	-02 P.C. Board using 4K × 8 ROMs
ROM 0	Address 2000-23FF (MSB) K0 034237-01	Address 2000-27FF (MSB) K0 034260-01	Address 2000-27FF (MSB) M0 034253-01
	Address 2000-23FF (LSB) J/K0 034238-01		
ROM 1	Address 2400-27FF (MSB) E0 034242-01	Address 2000-27FF (LSB) E0 034261-01	
	Address 2400-27FF (LSB) D0 034243-01		
ROM 2	Address 2800-3BFF (MSB) H/J1 034249-01	Address 2800-3BFF (MSB) H/J1 034264-01	Address 2800-3BFF (MSB) H2 034254-01
	Address 2800-3BFF (LSB) H0 034240-01		
ROM 3	Address 2C00-2FFF (MSB) H1 034250-01	Address 2800-2FFF (LSB) H1 034265-01	
	Address 2C00-2FFF (LSB) C0 034244-01		
ROM 4	Address 3000-33FF (MSB) K1 034247-01	Address 3000-37FF (MSB) K1 034262-01	Address 3000-37FF (MSB) J2 034255-01
	Address 3000-33FF (LSB) H/J0 034239-01		
ROM 5	Address 3400-37FF (MSB) E1 034252-01	Address 3000-37FF (LSB) E1 034267-01	
	Address 3400-37FF (LSB) A0 034246-01		
ROM 6	Address 3800-3BFF (MSB) J/K1 034248-01	Address 3800-3FFF (MSB) J/K1 034263-01	Address 3800-3FFF (MSB) K2 034256-01
	Address 3800-3BFF (LSB) F0 034241-01		
ROM 7	Address 3C00-3FFF (MSB) F1 034251-01	Address 3800-3FFF (LSB) F1 034266-01	
	Address 3C00-3FFF (LSB) B0 034245-01		

Figure 5-12 RF Shield Board Assembly
A034036-01 A



Parts List

Item	Part Number	Qty.	Description
1	030835-01	1	P.C. Board
2	2D-1016	30	Capacitor, Monolithic, .1 μ f, 50V
3	41-3003	22	Inductor, 100 μ h
4	52-003	7	Jumper, .600" Centers
5	75-E6106081	3	Wingscrew, #6-32 \times 1/2"
6	75-992302	3	Fastener, 1/4-Turn, #6-32, Nylon
7	79-517222	1	Connector, P.C. Mount, 44-Pin

